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SCIENCE AND INDUSTRY[1]

THE present age surpasses all previous epochs of history by the intense activity of the human race, the daring of its efforts, the magnitude of its accomplishments.

We know of periods in history where great wars, great political developments, migration, religious fervor, newly discovered lands, or other causes, brought forth considerable changes in some nations, but never was the movement so wide-spread in geographical location, never were impulses operating so rapidly, nor on so extensive a scale, as to-day.

We have not reached the end of this movement; quite on the contrary, it seems to gain in intensity as the years roll by.

While some few nations have taken the lead in certain lines of human endeavor, we know, on the other hand, that the same influences are at work even in the most remote corners of the world; countries which for ages have been dreaming dreams of rest, countries of which the political, intellectual, social or industrial conditions have remained practically unchanged for hundreds, nay thousands of years, begin to awaken; willingly or unwillingly, they too seem to undergo, albeit in a smaller degree, this all-pervading tendency of enterprise, this aggressive effort to better utilize their opportunities for material, social and intellectual betterment.

In other words, modern human dynamics have reached an intensity never witnessed before.

It looks to me as if all great feats re-

[1] Address of the president of the American Electrochemical Society, Pittsburgh, May, 1910.

corded in the history of our race sink to nothingness if compared to what human activity is accomplishing every day since ignorant, arrogant, emotional, spasmodic efforts are slowly but surely giving place to methodical and persistent work based on exact scientific knowledge.

Whether the human race has been made happier by all this, I shall not here try to decide. Happiness is a very subjective condition of mind, very difficult, if not impossible to measure or to compare: the happiness of the child or the savage and the happiness of the intellectually developed adult are two entirely different propositions. I believe, however, that even case-hardened pessimists ought to admit that our *opportunities for happiness* have considerably increased, even if so many people, not knowing better, continue to trample upon these very opportunities, blinded as they are by false ideals, or by misdirected aspirations.

True, the pessimist may point to the slums of large cities, to poverty, to vice, to unsatisfactory labor conditions, to high cost of living. But, what is all that compared with conditions in bygone ages? Where are the famines, the plagues, which not so long ago periodically devastated Europe, and which are still the scourge of some backward countries like India, China and Russia?

Political corruption, dishonesty and greed are still too much in evidence, and there is much room for higher ethics; on the other hand, anybody who wants to give himself the trouble to investigate real history will have to admit that the morals and conduct of life of many of the most exalted personages of the past, would fall far below the test of the plain average decent citizen of our republic to-day.

Most certainly, there is still abundant necessity for improvement; and our race will improve as long as we put more pride in raising better children than in finding an excuse for our littleness or a consolation for our failures, by bragging about the supposed importance of our ancestors.

Nowhere have the changes of this century been so accentuated as in our industrial enterprises. We know, furthermore, that just such industries, where the developments have been most staggering, are exactly those which have utilized scientific knowledge to the largest extent. Wherever the engineer has been able to put into practise the secrets which the scientist has wrung from nature's laws, there also do we see results so far in advance, as compared with what existed formerly, that only a man with a dead soul fails to be stirred up to admiration and enthusiasm.

The modern engineer, in intellectual partnership with the scientist, is asserting the possibilities of our race to a degree never dreamt of before: instead of cowing in wonder or fear like a savage before the forces of nature, instead of finding in these forces an object of superstition or terror, instead of perceiving in them merely an inspiration for literary or artistic effort, he learns the language of nature, listens to her laws, and then strengthened by her revelations, he fulfills the mission of the elect and sets himself to the task of applying his knowledge for the benefit of the whole race.

Let me assert it emphatically; the two most powerful men of our generation are the scientist and the engineer.

Society at large is far from realizing this fact, simply for the reason that the scientist and the engineer manifest their power not as despots, not as cruel tyrants. Their might is not put in evidence by the amount of chattel-slaves they hold in bondage, nor by the barbaric splendor of their lives; it is not marked by the devastation

wrought by armies; their work does not consist in conquering and subjugating weaker nations; we do not see them, glorified in painting and sculpture; we do not hear their exploits extolled in song and rhyme; no artists have had to record their triumphant homecoming, greeted as saviors and heroes while marching over the mutilated corpses of their fallen enemies; they do not use their power to sow sorrow, death and misery, or to steal and plunder or fill the museums of a city like Paris with treasures of art taken by force from weaker nations. No, the masses are unaware of the immense power of the scientist and the engineer because both of them modestly play the rôle of "the servant in the house"; their unassuming life is devoted not to slaughter, destruction or coercion, but to the service of mankind. They do not build useless pyramids cemented with the sweat and blood of overabundant slaves, monuments to vain glorious despots, witnesses to the small value which was put in ancient times on human life and on human labor.

But the modern engineer, applying the principles of science, raises buildings far superior in size and conception than any architecture of bygone ages can boast of; edifices incomparably more comfortable, more hygienic, more appropriate than anything built before. He raises those gigantic structures in as many days as it took years to build a temple.

In fact, after a few years, he is ready to pull the same buildings down, to erect better and bigger ones in order to suit advanced conditions, and nobody cares about the name of the architect or the engineer, nor does the builder care himself.

And why should anybody care? The dynamics of the age are producing changes at such a rapid rate, that nowadays any building, of whatever size it be, is begun with the feeling that before long it will have to come down to give place to new conditions. Erecting a twenty-story building in a city like New York is about like putting up a temporary tent, which may suit us for a while, but has to be taken down whenever conditions, in the onward march of civilization, demand it. Palaces and other buildings which would have made the pride of older nations are torn down now after a career of less than twenty years, to make room for the development of our cities, to allow larger and better adapted edifices to take their place, which probably in a relatively short time will follow their predecessors and be torn down in their turn, when our children begin to realize that they want streets four or five times wider than our now overcrowded thoroughfares.

The modern engineer and the scientist realize that much more enduring monuments than stone, brick or bronze will mark the work of this period: they know that the diffusion and application of exact knowledge is shaping the destiny of future generations and will afford more lasting evidence of their efforts than temples or statues; they believe that their work will not count merely for material betterment, but that improved material opportunities created by them will bring forth better people, higher ideals, a better society.

To put it tersely, I dare say that the last hundred years under the influence of the modern engineer and the scientist have done more for the betterment of the race than all the art, all the civilizing efforts, all the so-called classical literature, of past ages, for which some respectable people want us to have such an exaggerated reverence.

Consistent in their mission of true powerful men and of servants of our race, the

engineer and the scientist perform their work steadily but quietly; they are not appreciated by the unthinking multitude because of the fact that their modesty is usually as great as their achievements.

True, I know some of them who do not exactly "hide their light under a bushel"; but show me the most vain engineer or the most conceited scientist and he will appear like the very picture of meekness and modesty if you will put him alongside some artists, some writers of fiction, some opera singers, or opera composers.

Let me insist on the fact that every one of our betterments in material conditions, every increase in our opportunities in life has been the entering wedge of vastly improved social, political and ethical changes.

The steamships of to-day, to which the armadas of yore and the fleets of antiquity look like mere children's toys, bring distant nations, distant men, nearer together; so do the railroad, the press, the telegraph, the telephone.

Not only have time and distance been shortened by the industrial applications of science, but life has been lengthened in years, and still much more in accomplishments and in opportunities.

Improved means of communication do not only facilitate the exchange of products between far-away nations, and allow them to compete in quality and price in the most remote corners of the world's market, but they enable more lasting exchanges than merely those of material commodities; we intermingle, develop and distribute thoughts and knowledge which slowly but surely modify and perfect the political and ethical conditions of nations as well as of individuals.

Not so long ago, opportunities for travel, for education, wealth or comfort of existence, were given only to a very few; now in our modern community all these advantages have come within the reach of the multitude, and all this, thanks to our industrial developments.

Much has been said and written about the civilizing influence of the discovery of the printing press. Has it ever occurred to you that the printing press could accomplish very little if we had not invented the means for manufacturing cheap and good paper? In the same way, every facility which science and engineering has endowed the world with finds itself reflected in the ever-increasing development of printed publications. For one book that was written a few centuries ago, thousands, and better prepared ones, are published nowadays. Ancient authors had few competitors and few readers, and the latter could afford to remember the names of their authors, and greatly exaggerate their merits, and overawe following generations with the extent of their importance and hypnotize some of us into the belief that there are no good authors but dead authors, or ancient authors, an opinion unfortunately shared by some respectable pedagogues.

To-day, when illiteracy is no longer the rule but the exception, new ideas, new conceptions are carried to all points of the globe: measured, discussed, hacked to pieces, or developed, all this with a rapidity never attained heretofore; and I believe that one of the most important causes of our rapid mental and industrial progress is due to the very swiftness with which information and knowledge penetrate the masses.

The man who nowadays would try to stem the tide of ideas, or intellectual advance, would only succeed in making himself ridiculous.

In the middle ages, some devout people, not knowing better, could try to burn scientists and their books, and opposed for

a while the march of progress, because there were so very few scientists and so very few books to burn. But nowadays it would require more than all the combined blast furnaces of Pittsburgh to keep up this process of oxidation.

It helps a country like Russia very little to have some highly developed men, some great scientists, great philosophers, as long as the multitude of the rural population remain in ignorance and lowness; as long as so many people are prevented by unsatisfactory material conditions to profit by the influence of their better fellow men.

In a self-respecting community the benefits of modern conditions and opportunities for advancement are open for everybody and privileges of birth and class are now considered an anachronism, if not a crime, against the human race. Yet few men stop to compare the conditions of modern life with those of the good olden times. An average man who thinks himself underpaid and imagines he is living at a very modest pace, does not realize that when he is traveling in a modern railroad train he enjoys comforts and advantages never dreamt of by the richest or most powerful men, princes or kings, of scarcely a century ago; he forgets that his life is surer, that his health is better taken care of, than that of any potentate of former times; that the nation respects more permanently his rights as a citizen, than was the case of prime ministers of one or two hundred years ago; that his sons and daughters have better and surer opportunities of education and intellectual advancement, than the children of kings of past centuries; that there is no beautiful thought in this world, no knowledge, which is not accessible to him and everybody who can read.

Man only considers a thing a luxury as long as his fellow men can not get it, never mind whether it be a bit of glass or a diamond, a bicycle or an automobile; commodities of modern life cease to be considered as luxuries as soon as they become easily accessible to everybody.

Neither should we be too much disappointed in meeting so many people who seem to be oblivious to our improved conditions, as compared with those of former times. Society has been pushed ahead, against the will of the masses, by a few active, daring, restless men who forced the others to follow; just like a herd of unthinking sheep is unwillingly driven forward by the shepherd and his dogs. Many people among whom we live have truly been prodded into progress; they may properly be called remnants of bygone times, symptoms of mental atavism of the race; they do not properly fit in our age; they have passively drifted along on the advancing stream of centuries to be carried beyond where they properly belong, and now they constitute the ballast which impedes the dynamics of our modern generation.

It has been asserted so often by respectable people that science and industry cater only to our material welfare, and have little in common with culture, refinement or moral development; therefore I feel compelled to put special emphasis on this side of the question and to insist on the enormity of this error; on the contrary, the development of our industries, of our material prosperity, as well as the study and application of science, are the surest and most immediate forerunners of higher civic ideals, of an improved society, of a better race.

A clean, well nourished and well housed individual who can enjoy the comforts and advantages of modern surroundings, and leads an active, intelligent, productive, self-supporting and self-respecting life,

is certainly more of a man and a credit to his race than were some ancient saints who lived from alms and who spent their life in prayer and inaction, or who, for further edification of their followers, vowed never to change their clothes, nor wash nor shave nor comb themselves; he is more of a blessing to his fellow men than the useless drone who lives on the work of others and gives nothing in return but arrogant presumption based on fortune, rank or title inherited from his father.

If this be then the age of rational industrialism, of applied science, how then is it that in some industries quality is going down, while prices are soaring upwards?

Here again it is a noteworthy fact that just such commodities as are produced by so-called scientific industries are sold cheaper and are of better quality than ever before, and this cheapening of price or bettering in quality is almost proportionate to the amount of scientific knowledge involved in their production. Let us take, for instance, the chemical and the electrical industries, both based almost exclusively on well-developed scientific data. In both these groups of industries the chemist or the physicist has had full sway and the engineer has embodied their work in a practical form. Free and rational competition based on intellectual superiority has been their paramount factor of development. Competition based on artificial privileges like labor unions, tariff legislation, have played only a secondary rôle. While flour, meat, clothing and houses were considerably less expensive a hundred years ago than they are now, we find that acids, alkalies, salts, solvents, dyes, and, in general, almost all chemicals, are incomparably cheaper and of better quality than they were in the good olden times.

In some cases, the changes are remarkable. For instance, a ton of sulphuric acid sells now at the same price as two pounds of the same article were sold about a hundred and fifty years ago.

A similar cheapening can be found in many other chemicals, although their demand has immensely increased. Without going to extreme cases, we can state that there has been a steady improvement in most chemical manufacturing processes and that the public at large has had the benefit thereof. The same can be said of the electrical industry.

Compare this with industries which are still under the sway of the rule-of-thumb, which means the rule of the ignorant, or where competition is based on political protection; you will find that just such rule-of-thumb commodities where science plays no rôle, are those for which the public has to pay the highest price in return for the poorest article. Married men may follow this assertion from butcher's bills to ladies' hats, from house rents to servant girls.

For the poor chemist, it is almost an irony of fate that his science, by developing the "cyanide process," made gold cheaper and thereby reduced considerably the purchasing equivalent of his meager salary. In order to get square he will have to put himself now to the task of helping the engineer in the cheaper production of foodstuffs, or clothing, or take a hand in such tax reforms which may bring about a reduction of rent or may lessen other economic anomalies.

Notwithstanding all our progress, it is evident that we live in a transitory stage; next to enterprises and industries embodying the highest intellectual conceptions our century can offer, we find even in the most advanced countries examples of conditions

of affairs which seem truly an anachronism.

This must have impressed many of you who have happened to visit factories or mills where ignorance and greed seemed the two dominant factors, where the class of men and women employed, not to speak of child labor, seemed to have undergone the full curse of their sordid surroundings. Such places are to be found often where the mental condition of the directors does not enable them to go beyond the conception of size and where the whole tendency has been towards more, more, more, instead of towards better, better, better.

How different is this from some of our better engineering and chemical enterprises where everything bears the imprint of a steady effort towards progress and where employer and employed alike seem to undergo the uplifting force of intellectual aims. Such a happy condition of affairs is most likely to be encountered where the head is himself the scientific pioneer who has built up the enterprise.

Matters are not always so satisfactory where large organizations have got into the hand of a board of directors, who know little else of the technical side of the business than that it pays dividends, and for whom the main interesting factor is the value of the shares they own.

Whenever undertakings are ruled by such a class of men, we must not be astonished if their corporation counsel is more in evidence than their chemists or their engineers. What do they care if certain improvements in their processes might net them five per cent. more or mean better goods, if, on the other hand, they know that by a clever trick of law they can extract from the consuming public many times more; no wonder then if they have less time and less mental fitness for a principle of science or engineering involved in a new process, than for a conference with "eminent law counsel." If they can not alter nature's atomic weights, they may find a way of improving their invoice weights for the custom house to the detriment of Uncle Sam. I might use for our industries the forceful quotation of Shakespeare in Hamlet about the state of Denmark, as long as corporation lawyers of reputation are paid incomparably better and their services are sought for so much more eagerly than the very best chemists or the ablest engineers.

This brings to my mind the case of a company which held a charter to supply a certain city with illuminating gas, and which after enjoying a fortune-making monopoly for many years, found one day that special legislation had reduced the selling price of their product. Certain again of being able to upset this law, the company entered in long litigation, but finally, after repeated efforts, had to realize that even its best lawyers could not change matters. From that moment on, they began to inquire actively about better manufacturing processes. A friend of mine, who was requested to give his suggestion as to how they could improve their methods, replied as follows: "Up till now your company has been making *law*—now make *gas* and everything will come out all right."

Then again we find that, resourceful as the modern engineer or chemist is, his power is often simply a tool in the hands of ignorant but cunning men. In fact, our modern laws and society insure better reward for cunningness or slyness than for true intellectuality.

The very abundance of our natural resources may be partly to blame for this condition of affairs; in other countries, like Germany, with comparatively small natural means, competition shapes itself more

towards technical perfection. If we want to learn how to reduce what I would call our "nation waste," our German friends can give us valuable lessons. It is significant too that in large German engineering or chemical enterprises the board of directors is made up mostly of scientifically trained men, engineers, chemists and physicists. The entrance of the physicist in our industries has not yet become very evident, although in Germany it seems to be the rule, especially in electrical and other enterprises, to give to the physicist as much importance, and even more, than to the chemist; both of these scientific specialists leave the purely engineering problems to the qualified engineer.

The story was told to me how the head of one of the largest engineering firms in Germany won his spurs. Prices of copper were rising beyond precedent, and his merchant business associates insisted therefore that he should buy an amount of copper sufficiently large to supply them for their electric installations for several years to come. In the meantime, prices were going up faster and faster; but this did not seem to disturb the scientific director, who was eagerly following the results of some special research work, giving reliable data about transformers and high voltage transmissions. As he understood the law of Ohm, he knew that pretty soon, even if copper was three times higher in price, he could use so much thinner wire and save money in the end. What he foresaw happened; the price of copper dropped suddenly, and Ohm's law triumphed over copper speculators.

All this does not take away the fact that although some industries suffer from brutal ignorance, others have sometimes been handicapped by a too one-sided scientific organization; I know of some instances, especially in Germany, where very respectable enterprises have not utilized their available opportunities to the proper extent, because their scientific managers lacked good business sense. I have seen some industrial enterprises much held back by too much red tape and a choking amount of paper-wisdom. The most learned man without common sense or practical abilities can accomplish little except disappointments. Here is where the keen business man, with a practical turn of mind, with directness of purpose and good judgment, will every time show his advantages.

An overspecialized man, whether he be a biologist, a physicist, a chemist or an engineer, may lack the broadness of conception and action which characterizes true great men of many-sided development.

Then again, quite frequently the real field of usefulness of scientifically trained men is much misunderstood. For instance, it is a common mistake, made even by some engineers and physicians as well as by business men, to imagine that the main work of the chemist is confined to performing chemical analysis. This conception is about as absurd as to think that the main usefulness of an electrical engineer consists in making electrical tests, or that the essential work of the merchant is bookkeeping.

Many a good chemist has been thus prevented from showing his best abilities by the sheer ignorance of those who employed him.

In the development of some of our industries, nothing has played such an important rôle as scientific research work. To those who do not realize this, let me tell that not so long ago I had an opportunity in Philadelphia, to see that old electric machine of Benjamin Franklin, a small revolving glass globe mounted on a

wooden frame; this was about as far as electricity went a century ago. Shortly afterwards, I was confronted by those gigantic electric installations at Niagara Falls. To those who belittle the value of scientific research, I recommend a comparison between this and Franklin's machine, a mere scientific toy, a clumsy affair, that would at its best performance, and if the weather was not too damp, give off some small sparks; a contrivance so useless in its time and so devoid of apparent practical applications, that if some one had told to a "shrewd business man" of last century, what this field kept in store for us, he would merely have shrugged his shoulders in derision. But now behold the hundreds of thousands of electrical horsepower developed in those monstrous generators of Niagara Falls, sensitive as a slender nerve, and yet running with the precision of a watch; distributing power and light to distant cities like Toronto and Syracuse; running heavy railroad trains as surely as the tiny drill of the dentist; converting ores into metals; transforming hundreds of tons of brine daily into caustic soda and bleach; changing mixtures of sand and coal into carborundum; ennobling plain coal into graphite, or producing from coal and limestone new sources for illumination under the form of calcium carbide; or again fixing the nitrogen of the air on calcium carbide to change it into cyanamide, a most valuable synthetic fertilizer; and at every succeeding year, new chemical achievements of this kind are still being brought forward by a set of tireless workers.

Let me ask a fair question of those who underestimate the value of research: Has that stupendous gap between Franklin's toy and the power companies of Niagara Falls been bridged by anything but by scientific research of the highest order?

Some of the better educated people in this country begin to understand more and more the necessity of scientific research. Not so long ago, research work was only carried out in the laboratories of universities or in those of a few highly developed chemical or electrical companies; nowadays we find many intelligently conducted enterprises devoting a considerable annual outlay for systematic research work, where the resources of the chemist, the physicist and the biologist are used to good purpose.

Unfortunately, the scope and method of scientific research is difficult to understand for the uninitiated. Some people have only the haziest conceptions on this subject. Some manufacturers, totally unaware of the requirements involved in this work, in a half-skeptical way, grudgingly conclude to organize a research department, sometimes as a last resort to help them through some difficulties; others do it "to be in style" and simply to imitate their more successful competitors. Frequently they engage a young man with little experience, who, outside of what he studied in the technical school or at the university, has everything to learn, and who, besides that, is usually entrusted at the very start with the most difficult problems. His salary is none too high, and his action is very much restricted; sometimes he is forbidden to study the current practical methods, or so-called "manufacturing secrets," and is thus prevented from getting acquainted with the very problems he is supposed to solve. I have seen other cases where the time of the research chemist was filled with odd jobs of every kind. After a while, when practical results are not forthcoming fast enough, the bookkeeper confronts him with the list of expenses which have been incurred by his work; naturally some comments are ready at hand how the same money spent on a

good salesman would have shown immediate results, and so forth. Things go along that way for a while until the research department is abolished with the recurring remark: "Research does not pay, we've tried it."

In other cases, where some results are obtained, the matter is taken out of the hands of the chemist before he has had time to fairly try and develop it on a large scale. The subject is now entrusted to the superintendent or the foreman, who seldom is a friend of the scientifically trained man, and nearly always resents anything which might diminish the prestige of "established practical experience." Like in all new processes, defects are soon shown, and in the natural order of things, repeated failures and renewed trials on a practical scale are required before there is any possibility of regular utilization. The research chemist is allowed very little intervention at this stage of the work, and often, remarks are heard how imperfect the whole thing was "before so-and-so, the practical man, had his say." Finally initial expenses are charged against the research department, and profits credited to the "practical man."

A research department is a very difficult thing to organize and to run. It is not enough to provide a building and the necessary appliances; it is not enough to provide typewriters, card-indexing systems, and office force, and all the red tape connected with it; it is not sufficient to engage one or more well-behaved university- or college-graduates with the necessary helpers, and to let them work under an orderly businesslike manager. You might as well try to produce masterly paintings by installing an office management and a well organized paint and brush department, and a library containing all that has been written on the art of painting next to a splendidly equipped studio, and then leave out the real artist who will do the painting. Nay, the most important, the almost exclusive factor in a successful research laboratory is the research chemist himself. If he is not a man who has a soul alive with his subject, if he is not enthusiastically imbued with his opportunities, if he is not qualified for his task not only by scientific training but specially by a natural gift of discrimination between what is most important in a problem and what is secondary to it, you might as well fill a hall with the marble statues of Greek poets and imagine that they will write poetry for you.

Then if you find the man who has all the true qualifications, you may still paralyze his action by too much red tape, too much interference in his work. A good research chemist will do more and better work with pots and pans from the "ten-cent store" in a shed or in a barn, where he is his own master, than in a splendidly equipped laboratory where he gets irritated and interfered with by others who do not understand him.

I sometimes doubted whether it was really worth while for a young man to take up research work single handed, when so many people with abundant facilities were at work. What show, for instance, does an organic chemist have in studying a problem for which in Germany some large chemical companies employ hundreds of research chemists. To this I can answer that some of the most striking examples of successful research were the result of privately conducted work with modest means; in fact, I know of several instances where a research chemist who had created himself a reputation by work carried out privately under adverse circumstances, showed disappointing results as soon as he became part of a vast organization.

Even if you have the best qualified research chemists, do not expect immediate results. Do not forget that problems, apparingly most simple, require considerable time before they are thoroughly studied. Even in successful cases, it may easily require many, many years before a subject is so thoroughly elucidated that it can be taken up in practise.

Research is what gives a young man of strong individuality a chance to compete with those big industrial consolidations, the trusts, who, like elephants, look more imposing by their size than by their agility or perfection, and who, as that pachyderm, have many vulnerable spots, and are just as much handicapped by their lack of flexibility and by their ponderosity. Some steel manufacturers may be unable to think about anything but tonnage, and yet the work of some chemists has already indicated that the quality of steel of the future, or of its alloys, may be improved to such a degree that probably the average steel of to-day will look to our children as brittle and imperfect as pig iron appears to us. Neither should we lose sight of the fact that even to the most exclusive mechanical enterprises there is a chemical side, although the importance of the latter may not be apparent to the man who is not a chemist.

Let me give also a warning to such manufacturers who try to secure only by uncompromising secrecy, the money-making end of their industries.

As far as my experience goes, exaggerated secrecy is very often an indication of lack of knowledge, of industrial feebleness and incompetency; a miser is most of the time a man of small means.

If the chemists had been holding their results from each other, we should still be in the dark ages of the alchemist. No secrecy, however jealously carried out, can outweigh enlightened research work, protected by wise patent legislation. If our patent laws do not protect enough, then our prime duty becomes to change them until they answer their purpose as defined by the constitution of the United States. The care with which patent laws are administered is a direct measure of the industrial importance of a country. Piracy can not flourish, neither on the seas nor in intellectual property, if ethics of justice and equity can be made to prevail.

Every recorded success of the scientist or the engineer is an additional evidence that ignorant greed and brutal rapacity can not forever have full sway in this world, and that the rule of the sly and the shy leads to the abortion of progress. Furthermore, the results of their work, which bars out "chance," "luck" or "happenings," is their most eloquent language to convince their fellow men that if law-makers may still think that laws are made or unmade by them in Albany or Washington or Harrisburg, there is at least one law which can not be amended; at least one law which even the cleverest lawyers can not make to be interpreted in two different ways; a law which rules all men, large or small, poor or rich, to whatever nation they may belong; a law which rules the dead, and the unborn as well as the living; a law which requires no supreme court to test its validity; a law that can not be trifled with, which nobody and nothing can escape: the great unchangeable Law of Nature which rules the universe, mocks at men-made statutes and ordinances, and upsets and destroys everything which comes in conflict with her; the rigidly enforced law which tries to teach us our mistakes by suffering, by misery, by industrial or political crisis, by unhappiness, by war, so as to awaken us from our ignorant sleep, to show us our

misguided aims, and to command us to prepare a sounder, a happier condition for our children and future generations, while building up, during the trend of centuries, a slowly rising foundation for a higher humanity, a more god-like race.

Leo Hendrik Baekeland

THE GENERAL EDUCATION BOARD

At a meeting of the trustees of the General Education Board, held on May 24 in New York City, $682,450 in appropriations was voted. Of this sum $538,000 was appropriated conditionally for the endowment funds of eight colleges, $113,000 for the furtherance of demonstration work in agriculture throughout the southern states, and $31,450 for the salaries and expenses of special professors of secondary education in the several state universities of the south.

The appropriations voted in support of college endowments raised to $5,177,500 the sum already spent in this direction. The seventy colleges that have received these endowments during the last four years of the board's activities have each raised sums in endowment which taken with the board's gifts aggregate $23,670,500.

Conditional appropriations for endowment were made to these colleges in the following sums:

Cornell College, Mount Vernon, Ia., $50,000 in addition to a like amount subscribed at the last previous meeting of the board.

De Pauw University, Greencastle, Ind., $100,000.

Marietta College, Marietta, O., $60,000.

Allegheny College, Meadville, Pa., $100,000.

Central University, Danville, Ky., $75,000.

Drake University, Des Moines, Ia., $100,000.

Middlebury College, Middlebury, Vt., $50,000.

Transylvania University, Lexington, Ky., $50,000.

These eight colleges were selected from a list of twenty-nine who petitioned the board for assistance.

The sum of $113,000 appropriated for demonstration work in agriculture in the south was made in the furtherance of the efforts which Dr. Seaman A. Knapp, of the Department of Agriculture, is making in elevating agricultural conditions through the southern states by teaching intensive farming and the scientific methods of crop raising. In giving financial aid to this movement the General Education Board is cooperating with the department at Washington. Last year the board's contribution in this direction was $102,000, which was divided among the various states as follows: Florida, $5,000; Georgia, $32,000; South Carolina, $22,000; North Carolina, $24,000; Virginia, $22,000. In addition $8,000 was spent in the administration of this enterprise.

The money voted by the board for the salaries and traveling expenses of professors of secondary education in the south is to be spent, as previous appropriations have been, in fostering the growth of high schools. The board now has one such professor attached to the state universities of Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Louisiana, Arkansas, West Virginia and Kentucky, provision for the last of which was made at the meeting. The sole duty of these professors is to urge throughout their several fields the establishment of high schools.

The trustees of the board who attended the meeting were Frederick T. Gates, Robert C. Ogden, Walter H. Page, J. D. Rockefeller, Jr., Albert Shaw, Wallace Butterick and Starr J. Murphy, of New York; Edwin A. Alderman, president of the University of Virginia; Hollis B. Frissell, president of Hampton Institute; Henry Pratt Judson, president of the University of Chicago, and Wickliffe Rose, general agent of the Peabody Education Fund.

SCIENTIFIC NOTES AND NEWS

With a view of collecting material for the life of Alexander Agassiz, any one having any of his letters will confer a favor by sending them to his son, G. R. Agassiz, Museum of Comparative Zoology, Cambridge, Mass., U. S. A. The letters of any one who so wishes will be copied and the originals returned to the owner as soon as possible. If any persons are unwilling to part with the

original letters, will they kindly have copies made at the expense of G. R. Agassiz, and send them to him at their convenience?

SIR ARCHIBALD GEIKIE has been elected a foreign member of the Danish Academy of Sciences at Copenhagen.

OXFORD UNIVERSITY has conferred the degree of doctor of science on Mr. P. H. Cowell, F.R.S., and on Mr. A. C. Crommelin, both of the Royal Observatory, Greenwich. They have also been awarded jointly the Jannsen medal of the Société Astronomique de France.

PROFESSOR W. T. PORTER, of Harvard University, has been elected a corresponding member of the Royal Society of Physicians in Vienna.

THE University of Edinburgh has conferred its doctorate of laws on Commander Robert E. Peary.

DR. OTTO KLOTZ and Mr. J. S. Plaskett have been elected fellows of the Royal Society of Canada.

DR. ALFRED M. TOZZER, instructor in anthropology at Harvard University, and Mr. R. E. Merwin have returned from an expedition to British Guatemala and Honduras. They bring back a collection of antiquities from the four ruined cities which they discovered during the winter's work, and also a collection of entomological specimens for the Museum of Comparative Zoology.

DR. PHILIP P. CALVERT, assistant professor of zoology in the University of Pennsylvania, and Mrs. Calvert arrived in Philadelphia on May 17, from Costa Rica, after a year's residence in that country. They were in Cartago, their headquarters, at the time of the earthquake of May 4, which totally destroyed that town, but escaped unhurt. A brick partition wall fell into the room in which they were sitting, burying and destroying the living insect larvæ which were in rearing, some of the experiments having run for eleven months. On the following day they were able to recover from the ruins nearly all their other collections, notes, photographs, instruments, etc., and later to bring them home in safety. Many data on the seasonal distribution, larval forms and habits of Costa Rican Odonata (the principal objects of their investigations) have been secured.

DR. J. W. SPENCER sailed on the *Hellig Olaf* to spend the summer in Norway, to continue physiographic researches, commenced during earlier visits to that country. He will also attend the International Congress of Geologists in Stockholm.

DR. M. P. RAVENEL, professor of bacteriology, will represent the University of Wisconsin at the centennial celebration of the University of Berlin from October 10 to 13. Dr. Ravenel is also American delegate to the International Conference on Tuberculosis at Berlin in October, and the International Congress on Alimentary Hygiene and the Rational Feeding of Man, in Belgium.

PROFESSOR G. F. SWAIN, of Harvard University, attended the dedication of the Carnegie Engineering Building at Union University, Schenectady, N. Y., and delivered an address on "Limitations of Efficiency in Engineering Education."

ON May 16, Dr. E. L. Hewett lectured before the University of Colorado Scientific Society at Boulder, on his recent work on the ancient monuments at Copan in Honduras and Quirigua in Guatemala. He has been able to determine the order of development of the art, his results according perfectly with the dates worked out independently from the glyphs by his colleague Mr. Morley.

THE Croonian lecture of the Royal Society was delivered on May 26, by Dr. G. Klebs, professor of botany at the University of Halle, his subject being "Alterations of the Development and Forms of Plants as a Result of Environment."

DR. GEORGE FREDERIC BARKER, emeritus professor of physics in the University of Pennsylvania, died in Philadelphia on May 24, at the age of seventy-five years.

PROFESSOR WILLIAM P. BLAKE, emeritus professor of metallurgy, geology and mining and director of the School of Mines of the University of Arizona and territorial geologist, has died at the age of eighty-four years.

Professor Franklin C. Robinson, of Bowdoin College and the Medical School of Maine, died on May 25. He had been professor of chemistry in these institutions since his graduation in 1873. He was a member of the American Chemical Society, the Society of Chemical Industry, a fellow of the American Association for the Advancement of Science, member of the Maine State Board of Health, chairman of the Maine State Survey Commission, and ex-president of the American Public Health Association.

Robert H. Gordon, long interested in the geology of western Maryland and the donor of extensive collections of the finely preserved Lower Devonic fossils of this region to the U. S. National Museum and to Yale University, died on May 10, at the age of fifty-eight years.

Mr. W. R. Head, for many years a collector and student of Paleozoic sponges, died at his residence in Chicago on May 10, at the age of eighty-one years.

Dr. Robert Koch, professor of hygiene in the University of Berlin, died at Baden-Baden on May 27.

The well-known city engineer and paleontologist of Reval, Russia, August von Mickwitz, died on April 20 last at the age of sixty-one years. His best known work in paleontology treats of the Upper Cambric Obolidæ and Lingulidæ of western Russia.

By arrangement between the Bermuda Natural History Society and Harvard University the Bermuda Biological Station for Research will be open this summer for about six weeks beginning the middle of June, under conditions substantially like those of previous years. For particulars application should be made to Professor E. L. Mark, 109 Irving St., Cambridge, Mass.

In 1906, on recommendation of the then Italian minister of public instruction Boselli, there was created by royal decree the Comitato Nazionale per la Storia del Risorgimento. In 1909 this committee, consisting of nineteen members, was organized, with Senator Finali, president of the Court of Cassation, as its head. Among its members are Ernesto Nathan, syndic of Rome; Professors d'Ancona, Bosselli, Martini, Abba, Pitré and Casini; Marquis Emilio Visconti-Venosta, and Car. H. Nelson Gay, formerly of Boston, but for many years a resident of Rome, and the leading authority on the bibliography of the Risorgimento. The objects of the committee are (1) to establish in Rome, in the monument to Victor Emanuel, a museum, archives and a national library of the Risorgimento; (2) to promote Risorgimento museum and archives in the chief towns and cities of Italy; (3) to prepare and issue a bibliography; (4) to publish documents, and (5) to direct special works for illustrating the most important material. The committee already possesses many invaluable collections —the Crispi Papers, the Jessie White Mario Papers, Mazzini manuscripts, the Pepe correspondence, etc.; and when the new quarters are ready, there may be transferred to them the vast collections of the National Library at Rome. At a recent meeting, the committee chose a few foreign corresponding members, including George M. Trevelyan (England), Professors Harnack and Delbrück (Germany) and William Roscoe Thayer (United States).

The Smithsonian Institution has published a "Bibliography of Aeronautics," which has been issued as volume 55 of the Smithsonian Miscellaneous Collections. Nearly one thousand pages are required to present the 13,500 references which have been arranged alphabetically by authors, subjects and titles covering the subject down to July, 1909. Mr. Paul Brockett, the assistant librarian of the institution, is the compiler, and in his introduction he reviews the long association of the institution with aeronautics, pointing out that as early as 1861 assistance was solicited for carrying out experiments to cross the Atlantic by means of a balloon. Two years later there were published by the institution two papers on the general subject of aeronautics and since then thirty-five publications on various phases of the subject have been issued. In greater detail Mr. Brockett reviews the con-

tributions of Secretary Langley. He tells of the publication of his "Experiments in Aerodynamics" in 1891 and then of his further technical contribution on "The Internal Work of the Wind" in 1898. Very briefly is the story told of Langley's two flights with heavier-than-air machines.

SOME time ago an International Commission for the study of the effect of high altitude and solar radiation on medical and biological conditions was constituted, and Professor Pannwitz, of Charlottenburg was appointed president. We learn from the *British Medical Journal* that the commission has selected the Peak of Teneriffe as the site of its investigations. In view of the favorable conditions obtaining in the Canary Islands, and especially at the spot chosen, it was felt that it would be wise to study meteorological and astronomical as well as biological and medical problems. Professor Hergesell, the president of the international commission for scientific aerology, joined in the project, and when the observatory on the Peak of Teneriffe was opened, the German emperor presented the commission with a transportable house. On March 12 Professor Pannwitz started from Southampton with the members of the expedition, including Professor Barcroft and Dr. Douglas, of Cambridge, Professor Zuntz, of Berlin, and Dr. Neuberg, Dr. J. Mascat, Dr. Plasse (France), and Professor During and Professor H. von Schrötter, of Austria. The program includes the study of the effect of solar radiation (heliotherapy) in the treatment of pathological conditions; the continuation of the researches on biological processes at high altitudes, commenced by Professor Zuntz on Mont Rosa; and further observation of Halley's comet. A certain amount of preliminary work in meteorology has already been undertaken by Professor Hergesell and his assistants, and in this work the Prince of Monaco has materially assisted by lending his yacht, and by supporting the observatory in many ways. The Peak of Teneriffe offers special advantages for astronomical observations. The clear atmosphere at the peak, which is situated well above the cloud line and stands some 7,000 feet above the sea, renders the observatory a suitable place for studying the comet. The Spanish government has shown its interest by undertaking to extend the observatory, and has provided it with telegraphic communication.

PLANS have been adopted for the conduct of the Phipps Institute, now a department of the University of Pennsylvania, which we quote from the *Journal* of the American Medical Association. The work has been planned by a committee of physicians, comprising Drs. John H. Musser, David L. Edsall, Alexander C. Abbott and Charles H. Frazier. As soon as possible the new building will be erected at Seventh and Lombard Streets, the site first bought by Mr. Henry Phipps, and architects are now at work on the plans and specifications. It will be the most complete hospital for the treatment of consumptive patients in the United States. The trustees have elected the following men to direct the work of the institution: Director of the laboratory, Dr. Paul Lewis; director of the clinical department, Dr. Henry R. M. Landis, and director of the sociologic department, Alexander Wilson, who will be superintendent of the institute and with the director tor of the laboratory will devote all his time to the work. It has been decided to appropriate $5,000 for the maintenance in the laboratory work the first year and $1,800 for the clinical department. For the sociologic department the first appropriations will include $500 for an assistant to the superintendent; $2,300 for out-patient nurses; $1,200 for educational work, and $3,900 for emergency and special expenses. The institute will be governed by a board of directors composed of eight members, of which Provost C. C. Harrison, of the university, will be president ex-officio. The other members included the three heads of the institute and the following: Dr. John H. Musser, for medical council; Dr. Robert G. LeConte, of the board of trustees; George E. Gordon, representing the donor, and Dr. Charles J. Hatfield, of the Pennsylvania Society for the Prevention of Tuberculosis. Members of the advisory council, who

will hold a meeting once a year, are as follows: Pathological Department—Dr. William H. Welch, Baltimore; Dr. Theobald Smith, Boston; Dr. H. Gideon Wells, Chicago; Dr. Simon Flexner, New York. Clinical Department—Dr. James A. Miller, New York; Dr. Lawrason Brown, Saranac Lake, N. Y.; Dr. Joseph Pratt, Boston; Henry Baird Favill, Chicago. Sociologic Department—Dr. Samuel McC. Lindsay, New York; William H. Baldwin, Washington; Dr. Herman M. Biggs, New York; Dr. Samuel G. Dixon, Harrisburg, Pa.

UNIVERSITY AND EDUCATIONAL NEWS

Announcement is made of the receipt by Western Reserve University of a gift of $250,000 by Mr. H. M. Hanna, as an addition to the endowment of the medical department. The income from this gift is to be largely used in the clinical departments to enable the school to put these departments upon a university basis.

Mr. J. Ogden Armour has made a gift of $70,000 to the Armour Institute of Technology.

Dr. Roscoe Pound, who has successively held chairs of law at the University of Nebraska, Northwestern University and the University of Chicago, has been appointed Story professor of law in Harvard University. Dr. Pound was for many years director of the Nebraska Botanical Survey and is well known for his contributions to botany.

Professor Alexander S. Langsdorf has been appointed dean of the school of engineering of Washington University, to succeed Professor Calvin M. Woodward. Professor Langsdorf will continue in active charge of the Department of Electrical Engineering.

At the annual meeting of the regents of the University of Nebraska Adjunct Professor Walker and Adjunct Professor Pool, of the department of botany, were promoted, with the title of assistant professor of botany. Professor Pool was made curator of the university herbarium, also, and to Professor Walker's duties were added those of keeper of the botanical library.

At Cornell University instructors have been appointed as follows: M. M. Goldberg, in physics (promoted); Fred MacAllister, in botany; H. W. Mayes and M. H. Givens, in physiology and biochemistry (promoted).

Dr. M. Verworn, professor of physiology at the University of Göttingen has been called to Bonn to succeed the late Professor Pflüger.

DISCUSSION AND CORRESPONDENCE

ON THE APPARENT SINKING OF SURFACE ICE IN LAKES

To the Editor of Science: During the disintegration of the surface ice in a lake in the spring it is a matter of common observation by the natives that the ice suddenly appears to sink, the surface of the lake becoming clear in a few hours. The explanation of this apparent anomaly was difficult to find until it became clear to me as a result of a careful study of the effect of water temperatures in the St. Lawrence River on the growth and decay of ice. The ice sheet which forms on the surface of quiet water becomes thicker on the underside only by the conduction of heat. The total thickness of the ice which will form in a single winter depends not only on the mean air temperature measured in degrees, but on the mean water temperature measured in thousandths of a degree above or below the freezing point.

From measurements made with my special micro-thermometer I have found that the temperature of the water just under the surface ice in a lake or deep river is usually one or two hundredths of a degree above the freezing point, due to the lower layers of warmer water.

In the spring this temperature is considerably higher and the effect of the warmer underwater rapidly honeycombs the ice, thus assisting the sun when the surface snow is absent. In a flowing river the effect of wind and current is to loosen the ice and it is soon carried down by the stream. In a quiet lake

the honeycombed ice remains intact and becomes nothing more than a collection of vertical ice needles ready to topple over at the slightest touch. Outwardly this sheet of instability appears firm and compact. During the period of rotting the temperature of maximum density is slowly advancing upwards towards the ice sheet. Below the surface of maximum density convection of heat brings more and more warm water up from the bottom. There must be then a definite surface in the water at 4° C., below which the temperature is kept fairly uniform by convection and above which there is no movement in the water to disturb the existing temperature gradient up to the ice sheet. As soon as the 4° surface reaches the under side of the already honeycombed ice the change of temperature and movement of water must be fairly sudden, causing a rapid collapse of the whole structure. This no doubt accounts for the characteristic rattling noise when the phenomenon takes place. The ice needles soon melt in the warm water, which gives rise to the general belief that the ice sinks.

H. T. BARNES

McGILL UNIVERSITY,
April 16, 1910

PLANKTON

THE article of Professor Chas. E. Woodruff in SCIENCE of April 22 recalled to me observations I had made of phosphorescence of the sea. In connection with astronomic work I have sailed many seas, and have circumnavigated the globe in completing its astronomical girdle in longitude.

In the waters along southeastern Alaska, an area of fog, rain and little sunshine, I had observed most exquisite phosphorescence of the sea. When being rowed from the government steamer ashore, every dip of the oars showed them surrounded by that delicate bluish light of phosphorescence. When I walked over the beach of the receded tide every footprint was a blaze of this same light.

Some years subsequently when I started on my work round the world I looked forward with pleasure to beholding the grand phosphorescence of the tropics, under the belief that in the warmer waters and bright sunshine, the plankton—the cause of the phosphorescence—would be more densely distributed. In this however I was sadly disappointed.

In none of the tropical seas did I see any phosphorescence that could at all compare with what I described above. In vain have I stood at night at the bow or side of the steamer on a smooth sea watching for a fine display of phosphorescence. Now and then the comb of the small wave as the vessel parted the waters showed a fringe of the bluish light, and nothing more.

Arrhenius in his "Lehrbuch der Kosmischen Physik," p. 376, says that the phosphorescence of the sea "is most beautifully developed in the tropics," which is not my experience. Major Woodruff's explanation and application to the tropics of the destructive and lethal effect of light on the plankton agrees very well with my observations on the phosphorescence of the sea in different parts of the world.

OTTO KLOTZ

OBSERVATORY, OTTAWA,
April 28, 1910

ATHANASIUS KIRCHER AND THE GERM THEORY OF DISEASE

IN reference to Dr. Riley's note in SCIENCE for April 29, I am glad to make a prompt *amende honorable* for a hasty error of commission in regard to the magnifying power of Leeuwenhoek's microscopes, but it is difficult to see how any injustice has been done to Athanasius Kircher thereby, since the quality of his magnifying glass seems principally a matter of conjecture. If we accept Osler's adjustment of the matter of priority in the bacterial theory of infectious diseases, then the medical fame of the remarkable priest who was also a mathematician, physicist, optician, pathologist, Orientalist, musician and virtuoso, rests rather upon his seven experiments upon the nature of putrefaction[1] than upon his

[1] "Kircher Scrutinium," Romæ, 1658, caput VII., pp. 42–49.

central thesis: *Quod ex putredine perpetuo corpora quædam insensibilia in circumsita corpora exspirentur, quæ effluvia pestis seminaria dicuntur*,[2] the terminology of which immediately suggests the excerpts I have given from Fracastorius.

Kircher's "Scrutinium pestis," one of the acknowledged landmarks in medical progress, was published in Rome in 1658, at least seventeen years before Leeuwenhoek's discovery of the infusoria (1675) and twenty-five years before his Royal Society paper on the microorganisms found on the teeth (September 17, 1683); so that making every allowance for the skill and proficiency of seventeenth century opticians in grinding and polishing lenses, the question whether Kircher's lenses were better or worse than Leeuwenhoek's is one of those "improbable problems" that each one can settle according to his personal preferences. No one will deny that Kircher saw some minute organisms under his glass, but my quotation from Puschmann's "Handbuch" to the effect that this glass was "only a 32-power at best" was, I think, taken from a most authoritative source, Loeffler's "Vorlesungen," and certainly between this statement and Kircher's own romantic assertion that his lenses magnified a thousandfold, there is opportunity for extreme latitude of opinion. If Kircher's microscope still exists, say in the Vatican collection or any other collection left by him, the point might perhaps be settled by having the lenses examined.

Leeuwenhoek's paper of 1683[3] contains what appear to be accurate figurations of chains of bacilli as well as of individual spirilli and bacilli, and I am informed by a competent bacteriologist that it would be perfectly possible to see such chains and clumps with an occasional motile specimen through a glass of the power specified by Dr. Riley. All honor then to the father of microscopy, who, if he saw bacteria without staining methods, showed himself a genuine laboratory worker, by also drawing them. But neither the notations of Leeuwenhoek, nor the labors of Müller, Ehrenberg, Cohn and Nägeli, can compare with the gigantic strides made by Pasteur, who, as Virchow once passionately declared,[4] was the first to handle the bacterial theory of infection in "the grand style" (*im grossen Styl*), and thence to attempt a working theory of immunity and a practicable enlargement of Jenner's scheme of preventive inoculation. It is this that gives Pasteur his fixed and unassailable position as the true founder of bacteriology—at least so far as the history of medical science is concerned.

In reference to Dr. Henry Skinner's note on the mosquito theory of yellow fever,[5] I have been reminded by Professor Osler that there are authorities recently cited by Boyce[6] "that quite put Finley in the shade." Of these the claims of Dr. J. C. Nott (1848) have not been disputed, while a paper by Louis-Daniel-Beauperthuy, published in the "Gaceta Oficial de Cumana" (1853) is probably the best early contribution extant on the mosquito theory, containing a remarkably clear perception of the hæmolysis produced by toxins and venoms, and a clever note on the characteristic striped legs of the yellow fever mosquito (*Stegomyia calopus*).[7]

That the deductive theorists of one generation should rest upon the shoulders of their predecessors seems natural if we consider that only inductive demonstrations, like those of Harvey, Pasteur, Lister, Reed and Carroll, constitute real tangible proofs. The kinetic theory

[2] *Ibid.*, 29.

[3] A. Leeuwenhoek, "Ontledingen en Ontdekkingen," Leiden, 1696, 1. Stuk, pp. 12–15; the cut on p. 13 is reproduced by Loeffler and in Jordan's "General Bacteriology," Philadelphia, 1909, p. 18.

[4] "Wenn man jetzt auch darüber streitet, wer die ersten waren, welche diesen oder jenen Gedanken entwickelt haben—das kahn Niemand im Abrede stellen: Pasteur ist es gewesen, der im grossen Styl die Frage von der Uebertragung der Krankheiten durch bestimmte infectiöse Körper in die Hand genommen hat, und der darauf hin die Immunitätslehre zu begründen gesucht hat." Rudolf Virchow, *Verhandl. d. Berlin. med. Gesellsch.*, 1895, XXVI., 161.

[5] SCIENCE, April 22.

[6] Sir R. W. Boyce, "Mosquitoe or Man?" London, 1909, 23–28.

[7] *Ibid.*, 24–25.

of gases, one of the greatest modern physicists informs us, is "lost in antiquity." The atomic theory of matter is accurately stated in the "De rerum natura" of Lucretius, who got it from its Greek author Democritus; and Lord Kelvin, in his ingenious essay "Æpinus atomized," has indicated that the essential features of the electronic theory of matter had already been stated over a hundred years before, by the Rostock physicist Franz Hoch (1759). Who can doubt that the Greek scientists owed much to the learned Orientals and Egyptians who preceded them? We may take comfort then in the shrewd observation of the author of "Hudibras" that the speculative theorist is often several generations behindhand:

"For Anaxagoras long agone,
Saw hills, as well as you, in the moon;
And held the sun was but a piece
Of red hot iron, as big as Greece;
Believ'd the heavens were made of stone,
Because the sun had voided one;
And, rather than he would recant
The opinion, suffered banishment."

F. H. GARRISON

ARMY MEDICAL MUSEUM

A COMMENT ON ASPHYXIA

SOME surprising material is contained in Dr. John Auer's reply[1] to a note on the "Effect of Asphyxia on the Pupil," by A. H. Ryan, F. V. Guthrie and myself.[2] As he does not present any evidence against, nor even deny the accuracy of our observations on, the phenomenon to which we recalled attention by the statement that as a rule a very marked constriction of the pupils occurs in an early stage of asphyxia, no reply is necessary.

But since he attempts to account for our statement by saying that had we pushed our experiments further we "would have found the marked dilatation of the pupil which occurs in mammals during the second and third stages of asphyxia," as the senior author of the note I feel it incumbent upon me to make certain statements in order that those not thoroughly conversant with the subject may not receive erroneous impressions regarding the phenomena of asphyxia on the pupil.

It would seem that the classical phenomena of asphyxia are too well known to require mention, but in view of the above, I will here give an elementary statement of them taken from Starling,[3] to whom we referred in our communication:

The phenomena of asphyxia may be divided into three stages:

1. In the first stage, that of hyperpnœa, the respiratory movements are increased in amplitude and in rhythm. This increase affects at first both inspiratory and expiratory muscles. Gradually the force of the expiratory movements become increased out of all proportion to the inspiratory, and the first stage merges into:

2. The second, which consists of expiratory convulsions, in which almost every muscle of the body may be involved. Just at the end of the first stage consciousness is lost, and almost immediately after the loss of consciousness we may observe a number of phenomena extending to almost all the functions of the body, some of which have been already studied. Thus at this time the vasomotor center is excited, causing universal vascular constriction. There is often also secretion of saliva, inhibition or increase of intestinal movements, *constriction of the pupil,*[4] and so on.

3. At the end of the second minute after the stoppage of the aeration of the blood, the expiratory convulsions cease almost suddenly, and give way to slow deep inspirations. With each inspiratory spasm the animal stretches itself out, and opens its mouth widely as if gasping for breath. The whole stage is one of exhaustion; *the pupils dilate widely,*[4] and all reflexes are abolished. The pauses between the inspirations become longer and longer, until at the end of four or five minutes the animal takes its last breath.

Therefore, the implication that we were not aware that dilatation of the pupil occurs in a later stage of asphyxia is unworthy of further mention. Nor need any attention be paid to the term "original communication" applied to our note, for by this fact alone he shows that he had not read it even with

[1] SCIENCE, N. S., 1910, XXXI., 578.

[2] SCIENCE, N. S., 1910, XXXI., 395–396.

[3] "Elements of Human Physiology," 1907, 8th edition, pp. 404–405.

[4] Italics mine.

casual care. For therein we specifically stated that notwithstanding the fact that we could find no comprehensive treatise on this phenomenon in the sources at our command, still we had the impression that very thorough observations have long since been made and recorded, but felt justified in recording our observations in order to *recall* attention to the phenomenon. So, notwithstanding Dr. Auer's conviction to the contrary, I still hold that the material contained in our communication is not original.

Finally, had Dr. Auer made careful observations upon the frog's pupil he would have found that excision of the eye or stoppage of the frog's circulation, as by removing or tying off the heart, are alone followed by very marked asphyxial constriction of the pupil, and therefore the employment of additional asphyxial procedures is entirely superfluous. His conclusion might then well have been *that asphyxial changes in a frog's pupil differ from those in mammals in that there is not such a well-marked period of asphyxial pupillary dilatation.* It should be observed that we pointed out in our note that the post-mortem condition of the pupil in different mammals varies: in cats it is chiefly dilatation; in common gray rabbits constriction (as compared with the size of the normal pupil in diffuse daylight). From this it is obvious that the asphyxial changes in the frog's pupil as compared with those of the rabbit are in general similar, the chief difference being a well-marked but short period of dilatation in the rabbit.

C. C. Guthrie

Physiological Laboratory,
University of Pittsburgh

QUOTATIONS

"MEDICAL FREEDOM"

Makers of patent medicines, adulterators of drugs, and practitioners of the cults of mental and osteopathic healing are up in arms. They have persuaded a few well-intentioned but misled individuals to join them, and have formed the "National League for Medical Freedom" to oppose the efforts of practically all the reputable physicians in the country to consolidate the agencies of public health at Washington into one efficient department or bureau.

These efforts have been waxing stronger. The men of the American Medical Association and of the Committee of One Hundred on National Health, sanctioned by the Association for the Advancement of Science and headed by Professor Irving Fisher, of Yale, have won the approval of the entire press of the United States in urging the passage of their bill. In the various departments and bureaus of the federal government are lodged powers that can not be wielded effectively until they shall be coordinated under one head. Once united, they can be used in a great propaganda for educating the people against the habit of self-dosage and a resort to quack medicines for their ailments. By a campaign of prevention the bureau would break the prevalence of epidemics and infections between the states. It would work for the passage of laws that would guard the channels of inter-state commerce against the admission of adulterated drugs, and for the establishment of standards of purity and strength that would be copied by the states and cities of the nation.

The self-styled "League for Medical Freedom" quotes Professor Fisher accusingly as having said that the government might soon be appropriating millions yearly for the conduct of this bureau. If it should appropriate a million for every hundred thousand it now appropriates for the protection of the health of hogs and cattle in the United States, Professor Fisher's prophecy would be fulfilled, and no one would have cause for complaint but these friends of "freedom." Their cry is an old one and well understood.

License they mean, when liberty they cry.—The N. Y. *Times.*

SCIENTIFIC BOOKS

Ants. Their Structure, Development and Behavior. By William Morton Wheeler. New York, Columbia University Press, Macmillan Co., publishers. 1910.

One need not be very old to recall the time when ants were the most neglected of American Hymenoptera. I remember receiving a letter from Dr. W. H. Ashmead, some twenty years ago, in which he urged me to take up the study of ants. The necessary literature he said was not voluminous, material was easily obtained—he himself could supply a large series of species from Florida—and the field was a new and fertile one. Doubtless he urged others in the same manner, always without success. A few American students did a little in a desultory sort of way, but the real authorities on our ants were Europeans, Emery and Forel. Wasps, bees, ichneumons, sawflies, all were being studied and described with zeal; but as for the ants, probably some thought them too difficult, while others supposed they were sufficiently known, and for one reason or another nobody would have anything to do with them.

Although this apathy might well have been regretted then, it is impossible to regret it now. The foundations of American myrmecology had indeed been laid by the Europeans, but the building itself was destined to be erected, in the fullness of time, by an American. Dr. Wheeler published his first contributions to the subject in 1900, and it was at once apparent that the ants had come to their own. Since then he has labored incessantly, issuing several important papers every year, and now a large volume discussing every aspect of the life and structure of his favorites.

It is probably not too much to say that Dr. Wheeler's "Ants" is the best book on entomology ever published in this country. In a certain sense, the general text-books of several eminent authors are much more comprehensive; a mere treatise on ants seems a very limited affair, dealing with merely a fraction of a single order. This *a priori* judgment is quickly dispelled on reading the book. Here we have morphology, anatomy, embryology, psychology, physiology, sociology, paleontology, zoogeography, taxonomy and even philosophy dealt with in an illuminating manner! The ant is presented to us as the hub of the universe, and if there is any biological subject which may not be suggested by the study of myrmecology, it is probably of small consequence. No other entomological author has been in a position to give us a work at once so comprehensive and so critically written. Those who have produced admirable revisions of particular groups, have usually known little about development or habits, and have not so much as seemed aware that their subjects had a past. Those who have tried to cover the whole field, or a large part of it, have been obliged to compile much that could not be critically digested, no man being an expert in the whole of entomology. Such a work as the present may be taken to represent an optimum between two extremes, combining breadth with depth, neither being sacrificed to the other, while all is presented in a lucid and entertaining manner.

It is a model exponent of the new biology, of a method which will, we hope, eventually become as common as it is now rare. It is impossible to give any summary of the contents. Very interesting chapters are those on polymorphism, on harvesting and fungus growing ants, on the extraordinary honey-ants, on the slave-makers of various kinds, and on the numerous insects of different orders living in the nests of ants. The chapters on sensation, instinct and "plastic behavior" constitute a little treatise on psychology.

Dr. Wheeler remarks that three different views may be entertained concerning the behavior of ants: "First, it may be said that ants not only have images or ideas as the result of sensory stimulation, but are able to recall them at will, and to refer them to the past. This would imply that ants, like man, not only have memory, but also recollection. Second, it may be maintained that ants have images only as the result of sensory stimulation, but are unable to call them up at will, much less to refer them to the absent or the past. This would imply that the insects have sensory association, but not recollection. Third, it may be maintained that ants are unable to form images or ideas and are hence

devoid of memory." The third view is said to be wholly untenable, and the second is considered "far and away the most plausible." However, on an earlier page Forel is quoted to the effect that *Polyergus*, after plundering a nest, appears to remember whether any pupæ were left, and in that case returns for them: "memory alone, *i. e.*, the recollection that many pupæ still remain behind in the plundered nest, can induce them to return." This seems to imply the first of the three alternatives, unless we hold that departure from an *empty* nest discharges a psychological state which would otherwise act as a stimulus to return. At all events, Dr. Wheeler has little sympathy with the purely mechanical interpretation of insect behavior. "I have unintentionally sat on nests of *Vespa germanica* and *Pogonomyrmex barbatus*," he remarks, "and while I have no doubt that I myself acted reflexly under the circumstances, it will take quite an army of physiologists to convince me that these creatures were acting as nothing but reflex machines."

At the end of the chapter on the degenerate slave-makers there is a bit of sociology which is worth quoting:

> The zoologist, as such, is not concerned with the ethical and sociological aspects of parasitism, but the series of ants we have been considering in this and the four preceding chapters can not fail to arrest the attention of those to whom a knowledge of the paragon of social animals is after all one of the chief aims of existence. He who without prejudice studies the history of mankind will note that many organizations that thrive on the capital accumulated by other members of the community, without an adequate return in productive labor, bear a significant resemblance to many of the social parasites among ants. This resemblance has been studied by sociologists, who have also been able to point to detailed coincidences and analogies between human and animal parasitism in general. Space and the character of this work, of course, forbid a consideration of the various parasitic or semi-parasitic institutions and organizations—social, political, ecclesiastical and criminal—that have at their inception timidly struggled for adoption and support, and, after having obtained these, have grown great and insolent, only to degenerate into nuisances from which the sane and productive members of the community have the greatest difficulty in freeing themselves.

Not many adverse criticisms occur to one and these relate only to minor details. I have found some practical inconvenience from a lack of connection between the illustrations and the text. In some cases the illustrations (*e. g.*, those of *Leptanilla* on p. 262) arouse a lively curiosity, and one is disappointed not to find anywhere in the book a suitable explanation of the peculiarities figured. There are some slight errors and misprints, mostly of little consequence; I venture to remark that the bee cited on p. 209 is *Ceratina nanula*, not *nana*. It is rather discouraging to find two figures of *Cremastegaster* nests built round coccids, and not even the genus of the coccid given.

In the chapter on fossil ants, there is a curious quotation from Emery which refers to the ants of Sicilian amber as indicating the condition of things "at the beginning of the Tertiary," and assumes that the Sicilian and Prussian ambers were contemporaneous. As is properly stated on another page, the Sicilian amber is very much later than the Prussian, and neither belongs to the earlier part of the Tertiary. None of the European localities for fossil ants seem to be older than Oligocene, but the American Green River beds are now known to be Eocene, and the two species indicated therefrom by Scudder are apparently the oldest known ants. There is on p. 162 a reference (which I have not followed up) to ants in the amber of Nantucket, "which is attributed to the Tertiary." This should certainly be looked into, as there is a possibility that the amber referred to may be of Cretaceous age.

There are some very useful appendices: (*A*) Methods of Collecting, Mounting and Studying Ants; (*B*) Key to the North American forms, down to the subgenera; (*C*) Complete list of North American (north of Mexico) Ants, with localities; (*D*) Methods of Destroying Ants, and (*E*) a voluminous (though still incomplete!) Bibliography.

T. D. A. Cockerell

Distribution and Movements of Desert Plants. By VOLNEY M. SPALDING. Carnegie Institution of Washington, Publication No. 113, issued October 22, 1909.

Those who have for some years expected the publication of Professor Spalding's arduous and prolonged studies of the desert vegetation of the southwest, but more particularly in the vicinity of the Desert Botanical Laboratory, welcome it in a peculiar sense of gratification. The work, entitled as indicated above, embraces, to be sure, a wider range of observation than that within the purview of the leading author. The following are the themes discussed: Plant Association and Habitats; Local Distribution of Species, in which Cannon's studies on root distribution are made use of; The Lichens, by Professor Bruce Fink; Environmental and Historical Factors, including the geology and soils of the vicinity of the Laboratory Domain, by Professor C. F. Tolman and Professor B. E. Livingston, respectively; The Vegetative Groups, by Professor J. J. Thornber; The Origin of Desert Flora, by Dr. D. T. MacDougal; followed by a general discussion. This serious attempt to correlate the results of specialists in a vegetational study has everything to commend it, and the results which have emerged fully justify the expectation that this method of procedure will, for the future, serve an increasingly important rôle.

Aside from the hydrophytes, of minor interest in the work before us, the range of biological types found in the Tucson region includes two ecological groups, the xerophytes, generally distributed on the slopes and "mesas" so called, and the mesophytes, which are found especially near the watercourses and, as the result of irrigation, in the flood plains. This distinction in habitat is, however, operative only in general. The shade afforded by other plants and the nooks of sheltering rocks extend, very locally, into the drought period, the mesophytic conditions established by a rainy season. It thus comes about that antithetically pronounced mesophytes and xerophytes frequently stand close together in contingent habitats. It is to be noted, however, that the mesophytic conditions are relative and may not be compared with their analogues in the eastern or northern United States.

The winter and summer rains produce two mesophytic seasons of varying length, according to the character of the precipitation. These are times of rich vegetation of annuals, which, however, are not common to the two seasons. Thornber, by experiment, has shown that the temperature relations exhibited by the seeds of these annuals are prepotent in fixing their times of germination.

It is noted that the cryptogamic elements of the vegetation are relatively unimportant. The reviewer has had occasion to remark the very striking difference in this regard between the desert about Tucson, and that of north Zacatecas, where the land cryptogams, including algæ, lichens, bryophytes and pteridophytes are much more in evidence. This difference may be charged to a lower rate of evaporation in Zacatecas, as also may the general as well as local differences in the occurrence of phanerogamic as well as cryptogamic parasites. These, in the Tucson desert, are very inconspicuous; the cases noted by Spalding are *Phoradendron* on the mesquite and a root parasite *Orthocarpus,* studied by Cannon.

The mesquite is recognized as the dominant element in the mesquite forest association of the flood plain. While adapted to low degrees of atmospheric humidity, its demands for soil water are relatively high. Its maximum development is therefore in the flood plain, in which situation its roots are in correspondence with "a sufficient water supply." Its success in maintaining its foothold is attributed to the effective root system "always within reach of a permanent, deep water-supply." The reviewer takes this not of necessity to mean a water table. At any rate, it is certainly known that vast mesquite areas are to be found where no water table has been discoverable within several hundreds of feet. The high capillarity of the very fine, compact, very deep soil of the flood plain is sufficient to explain the presence of the mesquite.

The mesquite occurs also along washes, but

is of smaller size, and still smaller is it when present on the hillsides. The distribution, as indicated by its size, is evidently indicatory of the different amounts of available soil moisture. The reviewer has noted that large mesquite occurs on hillsides in Zacatecas, where there are hidden springs, as indicated by an actual outflow some distance away.

The mesquite in respect to water-supply is a physiological type to which belong, *e. g.*, *Koeberlinia spinosa*, *Holacanthus* sp. The water relations of these plants have given rise to a saying in Mexico: *Donde hay junco, hay aqua*, "where the junco occurs, there also is water," upon which faith many a dry well has been dug. This *à propos* of the occurrence of mesquite in the flood plain.

Of the more distinctly desert associations is Spalding's creosote-bush (*Larrea*) association. This is almost coincident with the mesa-like slopes of low gradient so characteristic of desert regions. Untoward physical conditions are here—a soil with little capacity for water retention, and underlaid by an impervious hardpan of caliche. To the most rigorous of these conditions the creosote-bush is the last to succumb, and is often the only plant with a perennial foothold.

The peculiarities of local distribution contingent upon the aspect of slopes, especially the steeper ones, have been extremely well studied by Professor Spalding, and the maps, made in detail and accuracy hitherto unequaled, by Mr. J. C. Blumer, to record observations, rather than merely to illustrate the principles involved, are in themselves a noteworthy contribution. Five species have been thus studied in detail. Of these, the most compelling example, by virtue of its size and appearance, is the sahuaro, *Cereus* (now *Carnegiea*) *giganteus*. This principally affects the southern aspects of the hills, the "optimum physical habitat" for this plant. The author has endeavored in this, as in the other cases treated, to refer this peculiar distribution to an efficient cause or set of causes. The search for these has led Professor Spalding to very important conclusions. Thus, the choice of habitat is, in many cases, conditioned by "difference in habit, and power of accommodation," leading to a fixation in particular situations. On the other hand, some plants are distinguished by a wide capacity for adjustment, and hence the restrictions upon choice of habitat are less strait and insistent. Here is pointed out that physiological adjustment may be of far more importance than structural "adaptation," but it appears—and this is of major importance—that in both cases "inherited peculiarities determine the limits of choice." Apparently the evidence does not indicate a progressive (racial) change in adaptation, but that a chance pre-fitness determines the possibilities of getting along.

Of chief importance appears to be the "range of temperature, though other factors, in certain cases at least, are involved." A constructive criticism at this point may be made that temperatures may be of this degree of importance in only a secondary way, but this also in certain cases. The view seems justified that the differences of insolation, and so of the temperatures, on slopes of opposite aspect, is effective in selection as between plants, which, during germination, quickly attain a sufficient (and again inherited) degree of structural or physiological resistance and those which are slow in this regard. The conclusions before us strongly indicate the great importance of the study of seedling development, and it may be believed that much light will thus be thrown on many still obscure questions of distribution.

Nevertheless, Professor Spalding makes a strong case for the direct effect of temperature, as *e. g.*, in the case of the sahuaro, whose limits of distribution appear to be set by temperature limits. It would be of the greatest interest and profit to compare, for this plant, its temperature environment, *e. g.*, in the Sta. Catalina Mountains and those of its present, generally northern, geographical range.

The so well-known individual isolation of desert plants has given force to the idea very generally accepted, that their interrelations are of minor importance. Pause is given to

this view, and while no detailed study is as yet available, it is pointed out that *vigorous competition is the rule and not the exception.* The "mutual accommodation" of certain plants as seen in the non-interference of the root systems (Cannon) is referred to; thus, the proximity of certain species involves the minimum of competition. Accommodation appears to the reviewer, therefore, as to Dr. Cannon, to be a minor degree of competition, or at least involves at some time a struggle. It frequently happens, *e. g.*, that the sheltering protection of an established plant results only in establishing active competition, frequently of minor but often of greater vigor, between it and its protegé. In this connection is of interest an account by Dr. Cannon, of the root system of *Cereus* (*Carnegiea*) *giganteus* and its mutual relations with those of three other species, discovering important topographic differences, which result that the roots of these plants, growing close together, are rarely in physical contact, because, chiefly, they do not occupy the same soil horizon, though "this does not mean that the plant (*Cereus*) is free from competition." It is further developed that the cacti are chiefly characterized by a relatively much more important lateral, shallow root system, and sees in this an important adjustment for aeration, in the absence of foliage, as well as to mechanical support, and for the remarkable readiness with which slight precipitation is made use of.

Professor C. F. Tolman gives an account of the geology of the vicinity of the Tumamoc Hills, where stands the laboratory. Two matters of more general interest emerge, namely, the origin of the wide slopes of gentle gradient, above referred to, and that of the "caliche," the calcareous hard-pan which plays an important rôle in its relation to the vegetation. Professor Tolman contends for the subaerial deposition of the clinoplains (Herrick) or conoplains (Ogalvie) and applies to these the simple, but unfortunately generic name of "slopes," to which the reviewer had previously applied the more specific term, foot-slope. To him—perhaps for human reasons alone—the latter appears the more descriptive and appropriate name. But we are more interested in Professor Tolman's views—concerning the materials composing the slopes. They are derived from the steeper mountain slopes above, which are, under semi-arid conditions, strongly attacked by torrential precipitation. The slope is, as said, of sub-aerial origin, in the formation of which temperature change and gravity play the leading parts, running water bearing "a varying rôle." This view is asserted chiefly for the reason that it controverts an earlier interpretation which calls upon a former marine or lacustrine extension to explain the topographical uniformity of the foot-slopes. Professor Tolman says that "deposition" in the playa is "most active during periods of water occupancy, when the dust from the mountains and slopes is caught by the water sheet." The evaluation of the factors at work is, however, confessedly difficult, but the reviewer suggests that, in undrained playas, the moving water sheet on the lower zones of the foot-slopes and the arroyo-imprisoned streams of their upper zones, consequent on heavy precipitation, are of great importance in eroding and carrying finer detritus to be laid down by the standing water sheet. As a matter of observation, this seems to be an important condition at the present day in certain regions.

The explanation of the caliche—this, Professor Blake's name, is retained—accords, with slight modification, with that of Professor Forbes. Caliche is, according to the latter, a "mixture of colloidal clay and carbonate (mainly) of lime," carried by the rain water downward into the soil to the depth, a few inches to three or four feet, where, as the result of desiccation, the hard-pan is formed. Professor Tolman finds, however, a ready supply of calcareous matter, coupled with an absence of drainage to remove it, to favor the encrustation. The rapidity with which caliche may be formed under experimental conditions out-of-doors may be remarkable—two inches in two years. The body of Professor Tolman's paper treats of the topography, geology and petrography (based on the work of Professor F. W. Guild) of the laboratory domain. This

part the reviewer leaves to a more capable pen. Professor B. E. Livingston contributes a section on the soils of this domain. He describes these soils in some detail, and there follow data derived from a detailed study of the soil moisture content at given depths for a period extended between October 3, 1907, and April 11, 1908. The importance of such information is shown in the fact that the effect of precipitation lags behind the precipitation itself, which "consideration emphasizes the inadequacy of mere precipitation data in any attempt to determine the moisture conditions under which the plants of any region live." Elsewhere, Professor Livingston points out that the "distribution of plant forms is perhaps more often determined by availability of oxygen than that of water," and this is of importance for desert plants, many of which appear to suffer from lack of oxygen in soils too abundantly supplied with moisture. Professor Spalding concludes that the facts established by Livingston show a remarkable degree of correspondence with the facts of distribution.

Professor J. J. Thornber, in a few pages, gives an exceedingly important summary of the vegetation groups of the domain. The unimportance of biennials is remarked, only three species being noted, in contrast to a total of 230 annuals. Of these, the winter annuals are three times more numerous than those of the summer. The total number of perennials is about equal to that of the annuals. Numerically the grasses (70 sp.) and the compositae (65 sp.) are dominant.

Of the lichens, of which at any rate 24 species are reported, enough, based on the study of them by Professor Bruce Fink, is said to indicate that a fruitful field of study awaits one who is disposed to attack these organisms in their desert habitat from an ecological point of view.

Dr. D. T. MacDougal deals trenchantly with the live question of the origin of desert plants. He sees little evidence that individual capacity in the soma has resulted in adaptation to desert conditions. The mesophytic forms which have extended to the desert regions flourish only during the mesophytic periods. Observed responses to true desert conditions are not necessarily adaptive, nor is it possible to refer highly specialized characters to the "supposedly causal conditions which they meet," such as the spines and glochidia of cacti. This is well said.

The weight of experimental evidence, derived from the work of Tower, Gager and MacDougal, the latter especially, indicates that the effects of environmental changes in the germ plasm are accountable for "irreversible changes in a hereditary line by which new combinations of qualities and new characters" become "fully transmissible." Dr. MacDougal properly points out the mental bias which has led to the regarding of desert plants as highly specialized, and mesophytes as not. What would the trained botanist of desert antecedents have thought on viewing, for the first time, a mesophytic forest!

It is clear from this cursory glance at the volume under review, embracing only a few of its more striking features, that a great deal of careful, insistent inquiry has been carried on by all the authors. This, it is equally evident, is leading us steadily in the direction of illuminating generalizations, which express more rational notions about plants than those which have held the botanical mind in thrall for many years. We are getting, as an example, a proper notion of adaptation, by which the word itself is condemned. This notion is not new, but is widely unaccepted in practise as yet, and this is well enough if it forces us to bring about an adequate investigation of the facts.

Much remains to do, or, better, shall we say truth if we admit that even the beginnings yet made are small. But beginnings in the right direction are notable, and Professor Spalding's work is such. The reviewer avows his warm admiration and regard for him who, after many years of rare service as a teacher, has devoted much of his remaining strength to a trying field of research, fruitful of basic truth in method and result.

Francis Ernest Lloyd
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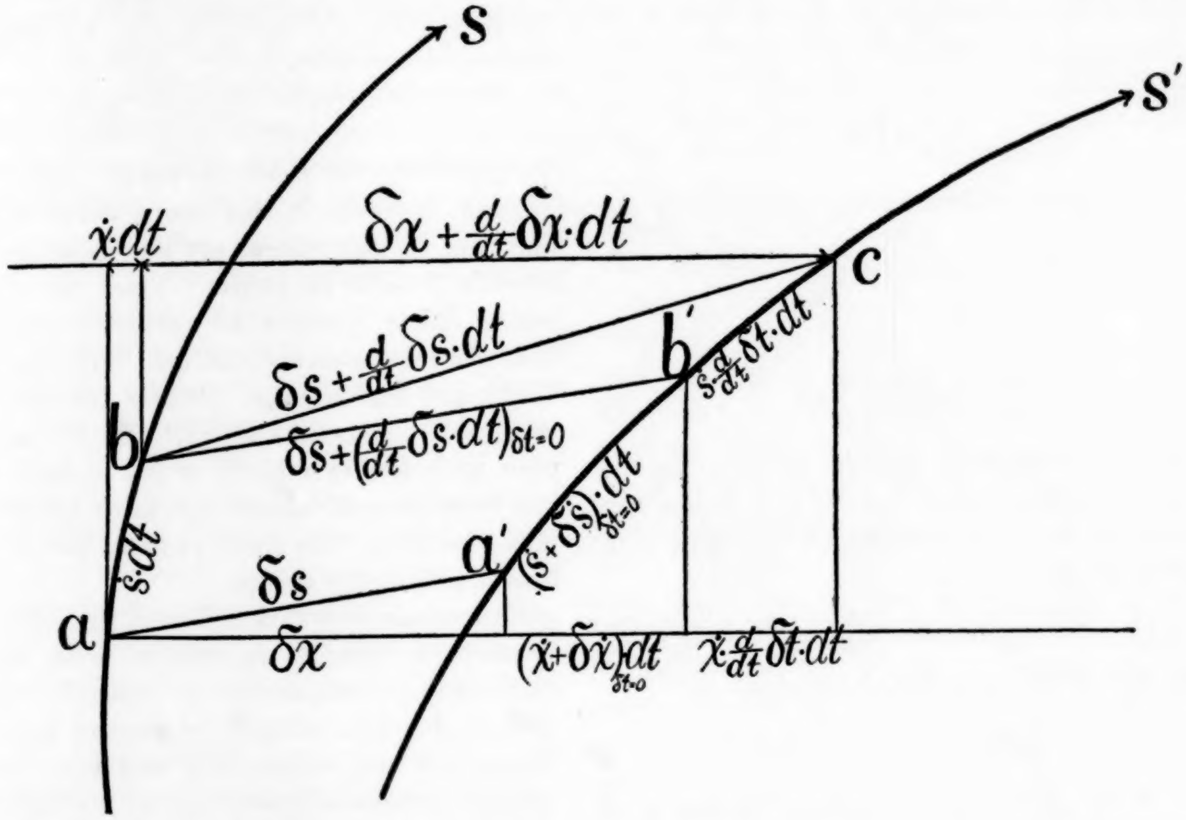
SPECIAL ARTICLES

VARIATIONS GRAPHICALLY

THE usual developments by which the calculus of variations is rigorously established, however cumbersome, are nevertheless satisfactory in so far as the reader knows what the aim is. But with a student, as a rule, they remain hazy. He acquiesces, of course, but he loses faith and the cloud may not be lifted during the whole of his subsequent course in the motion along it. Any two points, a and a', b and b', may therefore be regarded cotemporaneous at pleasure. We may express this by putting $\delta t = 0$, as in the figure. Any variation is possible, but the motion along s' must nevertheless be regarded as continuous; *i. e.*, the experimental motion is conceived as taking place, any assistance from without being admitted. The figure then shows at once, if we pass from a to b' in the two ways,



dynamics. I may therefore ask for indulgence if I publish the following simple treatment, because it has borne fruit and is intelligible to anybody who understands the equation $s = vt$.

Let s be the curve along which the motion of a particle actually takes place. Suppose it is to our advantage to consider what would happen if the motion proceeded along any other infinitely near curve s', selected at random but with the object stated. The notation would be less cumbersome without the differential coefficients $\dot{x}$, etc., but it is more direct to use them.

1. $\delta t = 0$. There are two cases. In the first, the curve s' is quite arbitrary, and so is

$$\delta x + (\dot{x} + \delta\dot{x})\,dt = \dot{x}dt + \delta x + \frac{d}{dt}\delta x \cdot dt,$$

or

$$\delta\dot{x} = \frac{d}{dt}\delta x \qquad (1)$$

the obvious meaning of the last equation.

2. δt *not zero*. In the second case the path s' is still arbitrary, but it may be regarded as a smooth wire along which a bead of the given mass slips by the same forces that move it naturally and without the wire along s. The two motions here are necessarily continuous and both are prescribed. Hence cotemporaneous points a and a', b and b', are prescribed, and an interval of time δt must elapse

in the second case if bc is to be any arbitrary displacement comparable to bb' above, § 1.

If aa' are chosen cotemporaneous, since both motions are continuous, the rate at which the interval will grow from nothing at a to δt at c, dt second later is

$$\frac{d}{dt}\delta t;$$

and the distance passed along the curve in this time excess,

$$\frac{d}{dt}\delta t \cdot dt$$

is therefore

$$\dot{x}\left(\frac{d}{dt}\delta t\right)dt$$

as the figure shows. Hence obviously as before

$$\delta x + (\dot{x} + \delta\dot{x})dt + \dot{x}\frac{d}{dt}\delta t \cdot dt = \dot{x}dt + \delta x + \frac{d}{dt}\delta x \cdot dt,$$

or

$$\frac{d}{dt}\delta x = \delta\dot{x} + \dot{x}\frac{d}{dt}\delta t. \tag{2}$$

It is also obvious that if we sum up the increments vectorially, from a to c in the two directions the same proposition will hold with regard to s;

$$\frac{d}{dt}\delta s = \delta\dot{s} + \dot{s}\frac{d}{dt}\delta t.$$

3. The important transformation

$$\frac{d}{dt}(\dot{x}\delta x) = \ddot{x}\delta x + \dot{x}\frac{d}{dt}\delta x$$

by which one passes from D'Alembert to Hamilton or to least action, respectively (see Webster's "Dynamics," which, by the way should be the text-book of every American university, patriotic or not), is a mere interpretation of the last term by the aid of equation (1) in the first case, of equation (2) in the second.

Finally with regard to variations in general it is clear that if ϕ is to have but one value at each point in space and is to vary at a single definite rate in each direction from that point, it is immaterial whether one uses the differentials, dx, dy, dz, meaning thereby that in a complete differentiation we must get back to the initial surface or region $\phi = c$; or the variations δx, δy, δz, meaning that, in general, our progress may terminate in any infinitely near region $\phi = d$, at pleasure, the same differential coefficients must be used. For along x, ϕ can not vary in any other way than at a rate, $\partial\phi/\partial x$, whether our absolute progress is to be dx or δx.

All this is simple enough, but with my students it has made the difference between the spiritless acceptation of what somebody else is supposed to understand and the satisfaction of an actual grasp of the subject.

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MOSQUITO HABITS AND MOSQUITO CONTROL

Until recently it was the general impression that all mosquitoes are blood-suckers and essentially alike in habits. Since the discovery of their relation to disease mosquitoes have been extensively studied, both systematically and biologically. While the study of mosquito biology has not by any means kept pace with the systematic work, a great deal has been learned about mosquito habits and it is now clear that there is great diversity of habits within the group.

To any one who has followed the literature, or become directly acquainted with the remarkable specializations in mosquito habits, it must be obvious that no control work can be carried out successfully and economically without intimate knowledge of the habits of these insects. Many persons, however, who are concerned with mosquitoes in a practical way, either directly in control work or as its advocates, have failed to appreciate this and hold the antiquated ideas. Work done on such a shallow basis must in many cases end in failure and disappointment.

Two striking examples, which have recently come to my notice, illustrate very well how such shortcomings lead to error. Sir Rubert W. Boyce, dean of the Liverpool School of Tropical Medicine, is the author of an interesting and excellent work which appeared recently under the title "Mosquito or Man?" While the book is written on broad lines it nevertheless contains specific statements, and

from such an author they command respect and are sure to be widely quoted. On page 96 we find this assertion:

> In many of the more low-lying swampy coasts crab-holes occur in enormous numbers in the sandy soil, and in them are bred vast numbers of mosquitoes. In fact they constitute the chief nuisance in those houses which are situated near the sea.

The region in question is the tropical American littoral and the mosquitoes concerned are the species of the genus *Deinocerites* and certain species of *Culex,* all of which breed exclusively in crab-holes. I can myself testify to the abundance of these mosquitoes in their very restricted habitat, but must challenge the learned author's statement that these mosquitoes are offensive in the manner he indicates. Even where their breeding places are in close proximity to houses these mosquitoes do not enter, much less bite. Out of hundreds of specimens, collected by ourselves and received from correspondents, not one shows traces of a blood-meal, nor have we been able to observe that they are in the least attracted to human beings. On the other hand, we have female specimens of *Culex extricator,* one of the crab-hole species, in which the abdomen, distended with food, is of a pale amber color, showing that the food taken was not vertebrate blood.

Such error, however, does no harm beyond the useless expenditure entailed in the destruction of these inoffensive insects. In the case of the control of the yellow-fever mosquito a wrong assumption becomes a more serious question. The Sanitary Department of the Isthmian Canal Commission deserves great credit for its effective work in the control of this mosquito, and it is primarily the thoroughness of this work that is making possible the rapid progress in the construction of the Panama Canal. The report of the Department of Sanitation for January, 1910, gives brief data on the character of this work and the gratifying results achieved in the reduction of this mosquito.

There can be no doubt that the yellow-fever mosquito has been reduced below the danger-point within the Canal Zone, a thing made easily possible by its habits of close association with man. The implied claim, however, that this mosquito has been eradicated from certain localities within the zone can hardly be accepted upon the evidence presented. This consists of a faulty experiment based upon the erroneous idea that the yellow-fever mosquito normally lays its eggs upon the surface of the water.

> At the native town in Gorgona wooden tubs with water were put under the houses on November 6, 1909, and between that time and January 6, 1910, no *Stegomyia* eggs were deposited. Had *Stegomyia* been present, eggs on the water surface would probably have been found.

The inference is that, because no larvæ appeared in the tubs and no eggs upon the surface of the water, no yellow-fever mosquitoes could be present in that locality. Such, however, is not the normal habit of oviposition of this mosquito. The eggs are deposited out of the water, at the edge of the water-film; here the eggs remain until they are submerged, when they promptly hatch. Eggs remaining out of the water retain their vitality a long time. In laboratory experiments eggs have been kept dry as long as five months and, when then submerged, produced larvæ; under favorable conditions out-of-doors it is to be supposed that they will survive even longer. Under the domestic arrangements of the more primitive tropical homes the conditions are ideal for the multiplication of this mosquito. The water receptacles in common use, which are the ordinary breeding places of this mosquito, are seldom, if ever, completely emptied; water is added from time to time, and thus whenever the water level is raised eggs can hatch. It will be readily seen that in the experiment quoted above eggs of the yellow-fever mosquito might easily have been present but could not have hatched, as the water in the tubs remained undisturbed.

FREDERICK KNAB

THE AMERICAN PHILOSOPHICAL SOCIETY

THE general meeting of the American Philosophical Society was held in the hall of the society, Independence Square, Philadelphia, on Thursday,

Friday and Saturday, April 21, 22 and 23. The session was opened on Thursday at 2 P.M. by the president, Dr. W. W. Keen, who occupied the chair throughout the meetings except at the afternoon session of Friday, which was presided over by Vice-President Professor William B. Scott, and the session of Saturday morning, when Vice-President Professor Edward C. Pickering presided. The afternoon of Saturday was devoted to a symposium on "Experimental Evolution," the principal papers being given by Herbert S. Jennings, professor of experimental zoology in Johns Hopkins University, on "Inheritance in Non-sexual and Self-fertilized Organisms"; George H. Shull, resident investigator, Station for Experimental Evolution, Carnegie Institution, Washington, on "Germinal Analysis through Hybridization," and Charles B. Davenport, director of Station for Experimental Evolution, Carnegie Institution, on "New Views about Reversion." Professor William L. Tower, of the University of Chicago, was also to have contributed a paper, but was prevented from attendance. After the principal papers, a number of other members participated in the discussion.

At the session on Saturday morning Professor C. L. Doolittle read an obituary notice of Simon Newcomb, late vice-president of the society, and presented a portrait of Professor Newcomb contributed by members of the society. The portrait was accepted by Vice-President Pickering.

On Friday evening a reception was held at the hall of the College of Physicians, at which Professor George E. Hale gave an illustrated lecture on the Mount Wilson Solar Observatory, describing the instruments and observations carried on at the observatory and at the laboratory in Pasadena connected with it. The session closed with an annual dinner held at the Bellevue Stratford on Saturday evening, April 23. About ninety members were present. At this dinner the toasts were as follows: "Benjamin Franklin," by Charles Francis Adams, Esq.; "Our Sister Societies," by President Ira Remsen; "Our Universities," by President James B. Angell; "The American Philosophical Society," by Dr. James W. Holland.

At the session on Friday morning the following were elected to membership:

Residents of the United States.—Simeon Eben Baldwin, LL.D., New Haven, Conn.; Francis G. Benedict, Ph.D., Boston, Mass.; Charles Francis Brush, Ph.D., LL.D., Cleveland, Ohio; Douglas Houghton Campbell, Ph.D., Palo Alto, Cal.; William Ernest Castle, Ph.D., Payson Park, Belmont, Mass.; George Byron Gordon, ScD., Philadelphia, Pa.; David Jayne Hill, LL.D., American Embassy, Berlin; Henry Clary Jones, Ph.D., Baltimore, Md.; Leo Loeb, M.D., Philadelphia, Pa.; James McCrea, Ardmore, Pa.; Richard Cockburn Maclaurin, F.R.S., LL.D. (Cantab.), Boston, Mass.; Benjamin O. Peirce, Ph.D., Cambridge, Mass.; Harry Fielding Reid, Ph.D., Baltimore, Md.; James Ford Rhodes, LL.D., Boston, Mass.; Owen Willans Richardson, M.A. (Cantab.), D.Sc. (Lond.), Princeton, N. J.

Foreign Residents.—Adolf von Baeyer, Ph.D., M.D., F.R.S., Munich; Madame S. Curie, Paris; Sir David Gill, K.C.B., Sc.D., LL.D., F.R.S., London; Edward Meyer, Ph.D., LL.D., Berlin; Charles Emile Picard, Paris.

In addition to the symposium on "Evolution," fifty-one papers were presented. A list of these with a brief summary of their contents follows.

The Great Japanese Embassy of 1860; The Forgotten Chapter in the History of International Amity and Commerce: PATTERSON DUBOIS, Philadelphia.

An account of this embassy and especially of its visit to the Philadelphia mint and investigation of our system of coinage, etc.

The Government of the United States in Theory and in Practise: C. STUART PATTERSON, Philadelphia.

The federal government has taken a highly centralized form very different from the ideals of the founder of the republic and at variance with the early theory of the balance of power between national government, state and citizen.

On some Philosophical Ideas in Zoroastrianism: A. V. WILLIAMS JACKSON, New York. (Read by title.)

Magical Observances in the Hindu Epic: E. WASHBURN HOPKINS, New Haven.

The practise of magic and recognition of its effects as portrayed in literature, notably in the epic, as contrasted with hymns and magic rules, which inculcate the rites only, formed the subject of this paper. Hindu literature has a number of works in which magic formulæ are given and hymns evidently written for the purpose of magic; but in the Hindu epic literature we see the application of these rules and hymns, and the magic which elsewhere is taught is here actively employed. One of the chief fields of application of magic in a war-epic is naturally that of magic weapons. The idea underlying magical weapons is identical with that of the savage of Australia.

By means of a mystic word, an ordinary weapon becomes bewitched and acquires supernatural power. Magic in sacrifice was shown to lead to human sacrifice, that out of the dead new life might arise. Water-magic was shown to result in the Hindu custom of touching water in making a vow, etc. The evil eye was found to be an article of faith with all the epic characters; also the belief in the king's healing touch, etc. The paper took up, one by one, all the observances noticed in the great epic, which is seven times as long as the Iliad and Odyssey put together.

The Bearded Venus: MORRIS JASTROW, Jr., Philadelphia.

In a hymn to the goddess Ishtar, the expression occurs that "she is bearded like the god Ashur." On the basis of this phrase, the conclusion has been drawn that the Babylonians and Assyrians conceived of Ishtar as both male and female.

It appears, however, that in astrological texts the planet Venus, who is identified with Ishtar, is frequently described as having a "beard"; and it is evident from the connection in which this phrase is used, as well as from explanatory remarks added in the astrological texts in question, that the reference is either to the brilliant, sparkling appearance of the planet or to the blurred appearance which suggests the rough fringes of a beard. The phrase in the hymn to Ishtar, therefore, is based upon the metaphor used of the planet Venus, and as the further context of the hymn shows, is intended to convey the idea that Ishtar is as "brilliant" as the solar god, Ashur.

The second part of the paper was devoted to an investigation of the evidence for a bearded Venus among the Greeks and Romans. It was shown that most of the passages upon which such an hypothesis was based were capable of a different explanation. So, for example, the statement of Herodotus that the priestess of the war goddess of the Carians (whom Herodotus identified with Athene), grows a beard when hostilities are brewing, evidently refers to a prevailing custom, according to which the priestess puts on a beard in order to emphasize, in accord with the principle of sympathetic magic, the hope that the war goddess will manifest her power and strength. The beard in this case is the symbol of the warrior, and it may be that the significant passage in Servius, who states that there was an image of a bearded Venus in Cyprus, is to be explained by some similar custom.

The conclusion reached by Professor Jastrow was that it was more than doubtful whether in the Greek Pantheon, as little as in that of Babylonia and Assyria, there was such a figure as a "bearded lady." The problem was distinct from that of "hermaphroditism," which is a comparatively late phenomenon in Greek religion, the earliest reference to it being in Theophrastus; nor does it follow from the fact that the goddess in question, both among the Semites and Aryans, was occasionally viewed as having the traits of a male deity, that she would be regarded anywhere at one and the same time as both male and female.

Early Greek Theories of Sound and Consonance: WM. ROMAINE NEWBOLD, Philadelphia.

Historical Aspect of German Mysticism of the Fourteenth Century: KUNO FRANCKE, Cambridge.

A characteristic feature of all Romantic literature is the tendency to oscillate between the extremes of symbolism and naturalism. The dwelling together of these two extremes in particularly intense and particularly refined individuals is nothing accidental. It is founded on the inner affinity between symbolism and naturalism, on their both springing from the common root of an unusually high-strung subjectivity. All truly artistic grasp of life comes from within. The symbolist finds the essence of things in his own inner self. In the throng of shapes and images that arise before him from within he sees the true reality. The tangible and visible he replaces by a world of his own creation, a world of higher, finer, more spiritual values. But the naturalistic artist also is far removed from being a mere imitator of outward reality. He transports himself into the inner life of things, he feels that the whole variety of the outer world streams forth from one mighty source. He feels akin to this mighty power, he feels the impulse to create a living world. His art, therefore, although seemingly objective, is, like that of the symbolist, the product of his own high-pitched subjectivity.

In the few greatest artists of all ages, in a Dante, Shakespeare, Goethe, these two diverging but kindred tendencies, the symbolistic and the naturalistic, are melted together into an indissoluble unity. In less harmonious, more erratic personalities, such as Amadeus Hoffmann, Poe, Ibsen, Hauptmann and other Romanticists, there is, instead of this unity of contrasting elements, a constant clash between them, a continuous oscillation between extravagant symbolism on the one hand, and inexorable naturalism on the other.

A striking illustration of this peculiarity of Romantic literature is to be found in the writing of the German mystics of the fourteenth century.

To an analysis of the symbolistic and naturalistic elements of German mystic literature of the fourteenth century the bulk of the paper was devoted.

The New Shakespeare Discoveries: Felix E. Schelling, Philadelphia.

The newly discovered references to Shakespeare include amongst other things an anecdote concerning his father, a reference to Shakespeare in the capacity of a tax-payer in the parish of St. Helen's Bishops Gate, some other information concerning the coat of arms finally granted to Shakespeare, a reference to Shakespeare as the designer of an impressa for the Earl of Rutland in 1613, and several of the discoveries by Professor C. W. Wallace, recently made in the Public Record Office in London. The chief amongst these is the final settlement of the question of the value and proportion of the interest of Shakespeare in both the Blackfriar's and the Globe theaters and a definite proof of his place of abode during the period of some years from 1598 onward.

A German Monk of the Eleventh Century: A. C. Howland, Philadelphia.

A study of the life and writings of Othloh of St. Emmeram to illustrate the reform tendencies in the religious life of south Germany in the eleventh century. The writings of Othloh are of a peculiarly intimate character and contain more autobiographical material than is to be found in any other writings of the period. Besides the information they give us of the writer's own feelings and ideals they exhibit the two chief characteristics of German religious tendencies in this time—the fostering of an active intellectual life and the inculcation of practical morality. The paper describes the early education of Othloh, his ambition to acquire culture, which led him at one time to contemplate studying in the Moorish schools of Spain, his sudden conversion to the monastic life by what he considered a miracle and his struggles to reconcile the ideals of this new life with his old devotion to poetry and pagan learning. Examples are also given of his moral teachings and his interest in the every-day life of the plain people about him.

New Fields of German-American Research: M. D. Learned, Philadelphia.

Rich fields for investigation may be found in the German archives for researches on the causes of German emigration to the United States. Another promising field is the question of the influence of American ideas on modern German culture.

The Real Meaning of the Controversy concerning Pragmatism: Albert Schinz, Bryn Mawr.

While truth remains always the same, each aspect of truth which we wish to emphasize depends upon accidental circumstances. This is the case of pragmatism, which gives the useful as the criterion of truth. There are two sorts of useful, the scientifically useful and the socially or morally useful. There are conflicts between the two. In such cases of conflict, pragmatists try to substitute the second for the first, *e. g.*, they advocate freedom of the will, or religion on the ground of their moral usefulness. The conclusion is that pragmatism is not really a philosophy of truth, but a philosophy of the expedient, socially speaking; and although pragmatists refuse to acknowledge openly what is clearly contained in their premises, it implies stopping science wherever science conflicts with morality. The author realizes the importance of the social problem involved, but would propose another solution. Instead of stopping science, let us be very cautious in spreading abroad the results of science; let us do away with such institutions as university extension and popular science in magazines. Such pseudo-philosophies like pragmatism ought to be rendered useless by a better economy of scientific truth.

Physical Notes on Meteor Crater, Arizona: William F. Magie, Princeton.

Meteor Crater is a vast crater situated in Coconino County, Arizona, formed by the impact of an iron meteorite, or group of meteorites. Scattered specimens of these meteorites (the Canyon Diabolo siderites and the shale ball siderites) are found around the crater, but the main mass has not yet been found. It probably is buried 1,000 feet below the surface.

1. The Canyon Diabolo iron shows a magnetic permeability not very different from that of cast iron. The shale ball iron seems to be generally similar to it in its magnetic properties. Several observations indicate an intrinsic magnetization, peculiarly arranged, in the shale ball iron. The sheets of iron oxide, formed from the shale ball iron, are often intrinsically magnetic, but have very low permeability.

The magnetic field of the crater shows no local peculiarities such as would be expected from the presence of a large continuous mass of iron. The

inference is that the mass is fragmentary, perhaps intrinsically magnetized, and also perhaps largely oxidized.

2. The distribution of the ejected material and the inclinations of the exposed strata around the crater wall show a remarkable symmetry with respect to a nearly north-and-south axis. This symmetry, even in details, appears in holes made by bullets in a suitable mass of compacted powder. The inference is that the crater was formed by a projectile.

3. The mass ejected is estimated at 330 million tons. The energy used to lift it out of the hole is a negligible fraction of the energy expended. Most of the energy expended was used in crushing the rock. An estimate based on the assumption that the powdered sandstone was heated to 2,500° C. would indicate an expenditure of 92.5×10^{12} ft. tons of energy. Taking everything into account, it seems reasonable to estimate in all an expenditure of 60×10^{12} ft. tons of energy.

Taking this for the energy expended, and estimating the probable velocity of the meteor as lying between 3 and 48 miles a second, the mass of the meteoric group would lie between 15 million and 60 thousand tons.

The size and shape of the crater lead one to estimate a mass larger than this lowest limit; and the final estimate is that the mass is 400 thousand tons and that its velocity was from 18 to 20 miles a second.

The Conversion of the Energy of Carbon into Electrical Energy by Solution in Iron: PAUL R. HEYL, Philadelphia.

It is found that carbon dissolves in molten iron with a liberation of energy, which, by providing a suitable negative element, may be obtained as an electric current. The electromotive force thus developed has not yet been definitely determined, but is probably not more than one or two hundredths of a volt. There is no possibility of compounding this electromotive force with the accompanying thermal effect, as the two are opposite in direction.

The One-fluid Theory of Electricity: FRANCIS E. NIPHER, St. Louis.

The author has shown in a former paper that what have been taken for discharges from the positive terminal of an electrical machine are really optical illusions. The positive discharge is really an inflow of the electrical discharge which flows outward from the negative terminal. This is in harmony with the one-fluid theory of Franklin. With this paper he presents photographic plates showing the discharge from its first stages until the disruptive spark appears. These plates fully confirm the former conclusion that there is no positive electrical discharge. The discharge comes from the negative terminal and goes to the positive.

The illusion which has led to the idea of a positive discharge is compared to one which might prevail if Niagara Falls should suddenly recede from Lake Ontario to Lake Erie. It might deceive us into the idea that there had been a positive discharge into Lake Erie.

The Past and Present Status of the Ether: A. G. WEBSTER, Worcester.

The history of the conception of the luminiferous ether was covered from the time of Newton and Huygens to the present. For the last hundred years the belief in the ether as necessary to transmit light has been universal. Lord Kelvin devoted most of his life to establishing its properties. The various mechanical theories were succeeded by Maxwell's successful electromagnetic theory, confirmed twenty years later by the electric wave experiments of Hertz. To explain astronomical aberration and the phenomena due to the earth's motion Maxwell's theory was severely strained, and was perfected by Lorentz. The classic experiment of Michelson on the apparent fixity of the ether to the earth in its motion, was explained by Lorentz, though by the violent assumption that motion changes the dimensions of bodies, and that the local time of a moving observer is different from that of an observer at rest. From this comes Einstein's principle of relativity, which profoundly modifies our ideas of space and time, and leads many radicals to abandon the ether. The "ether crisis" is the leading question in physics to-day.

The Ether Drift: AUGUSTUS TROWBRIDGE, Princeton.

Professor Trowbridge spoke very briefly of the general question of relative motion of matter and the ether, and pointed out that in spite of the experimental work of various investigators we are still in doubt as to whether the earth in its motion through ether-filled space entrains the ether in its motion or not. Next he explained in what respect the experimental method adopted by Professor Mendenhall and himself differed from that of former investigators so as to be free from the objections which have rendered the previous work inconclusive. Lastly a report of progress of

the work which is not yet completed and for the speedy completion of which the Rumford Fund has made an appropriation.

The Effects of Temperature on Fluorescence and Phosphorescence: E. L. NICHOLS, Ithaca.

A summary of observations on fluorescence and phosphorescence from the temperature of liquid air to ordinary temperatures, showing that the theory of Lenard is inadequate to correlate all the facts.

Infra-red and Ultra-violet Landscapes: ROBERT WILLIAMS WOOD, Baltimore.

Photographs taken with infra-red and ultra-violet light, using appropriate absorption screens, show greatly altered contrasts. Thus some substances which are white when viewed by ordinary light appear black when photographed with ultra-violet light. By such photographs it may be possible to obtain additional details concerning the surface markings of the moon and planets.

New Optical Properties of Mercury Vapor: ROBERT WILLIAMS WOOD, Baltimore.

Newton's Rings as Zone-plates: ROBERT WILLIAMS WOOD, Baltimore.

A zone plate may be automatically produced by photographing Newton's rings in monochromatic light. This may be copied by ruling circles with a diamond on a glass plate mounted on a turn table, the photograph being used as a guide to determine the radii of the rays. Copies of this may then be made in celluloid.

New Surgery of the Viscera of the Chest: ALEXIS CARREL, New York.

The Cause of Epidemic Infantile Paralysis: SIMON FLEXNER, New York.

A report on the experimental study of poliomyelitis in monkeys which has yielded a large number of important facts relating to the spontaneous disease in man. The nature of the virus has been discovered, many of its properties have been ascertained, some of its immunity effects have been established, the clinical and pathological peculiarities of the disease have been elucidated, and a basis has been secured on which to develop measures of prevention.

Description of the Brain of an Eminent Chemist and Geologist (a member of this Society) together with a Note concerning the Size of the Callosum in Eminent Men: EDWARD ANTHONY SPITZKA, Philadelphia.

A description of the brain of Persifor Frazer, author of many books, reports and papers on geology, chemistry, mathematical problems and handwriting.

The brain was normal, in good condition, and weighed 1,580 grams, being about 250 grams over that of average persons of his age. The ratio of weight of cerebellum, to that of the cerebrum, is as 1:8.07; while among ordinary men it averages 1:7.5.

Among the pronounced anatomic features which place this brain in the superior class, aside from the weight and fissural complexity, are: (1) superior degree of differentiation of the motor centers for the utterance of speech and for word-arrangement, (2) great redundancy of the right subparietal region encroaching upon and shortening the sylvian fissure, (3) a large corpus callosum, or commissural bundle of fibers joining the two hemispheres of the cerebrum together, affording a superior degree of coordination between them. In Dr. Frazer's brain it measures, in cross-section area, 10.26 sq. cm. The average size of the callosum in ordinary persons is somewat less than 6 sq. cm. Some years ago the author first showed that many eminent men, though not all, have a larger callosum, out of proportion even, to the factor of brain-weight alone. The callosum is most fully developed in the human species concomitantly with the greater development of cerebral parts; it may be looked upon as an index of the elaboration of at least one division of the association systems—*i. e.*, those concerned with bilateral coordinations.

The redundancy of the right posterior association area in Dr. Frazer's brain may be interpreted, in the light of previous investigations on other brains, as corresponding to a superior ability to register and compare the impressions in the visual, auditory and tactile spheres (the concrete-concept sphere).

A Brain of about One Half the Average Weight from an Intelligent White Man: BURT G. WILDER, Ithaca. (Illustrated by specimens, photographs and diagrams.) (Read by title.)

The Poisonous Group in the Protein Molecule: VICTOR C. VAUGHAN, Ann Arbor. (Read by title.)

Characteristics of Existing Continental Glaciers: WILLIAM H. HOBBS, Los Angeles, Cal. (Read by title.)

Dermal Bones of Paramylodon from the Asphaltum Deposits of Rancho la Brea, near Los Angeles, Cal.: WILLIAM J. SINCLAIR, Princeton.

The paper describes the mode of occurrence,

shape and microscopic structure of the skin bones of an edentate animal from the Los Angeles asphaltum beds. These bones, which are small pebble-like elements in the skin, resemble closely similar bones occurring in a piece of skin found in a cave at Last Hope Inlet, Patagonia. They are also known to occur in *Mylodon*, a genus of ground sloths formerly living in North and South America. As the structure of the skin bones in *Mylodon* is quite different from what it is in *Grypotherium*, the form from the Last Hope Inlet locality, it was a matter of interest to find out to which of these genera the specimens from the asphalt showed the closer resemblance. Thin sections of the bones were cut and these prove that *Paramylodon* from the asphaltum beds is almost identical, in the structure of the skin bones, with *Grypotherium*, a contemporary of early man in Patagonia.

The Restored Skeleton of Leptauchenia decora: William J. Sinclair, Princeton.

A restoration of the skeleton of this small extinct hoofed animal from South Dakota has been prepared from specimens in the collection of Princeton University. Hitherto only the skull has been figured. The restoration shows the animal to have been about twenty-one inches long from tip of nose to root of tail and about ten inches high at the shoulder.

Correlation of the Pleistocene of the New and Old Worlds: Henry Fairfield Osborn, New York. (Read by title.)

The Primates of the Old and the New Worlds, together with Man: Giuseppe Sergi, Rome, Italy. (Read by title.)

A Note on Antarctic Geology: William Morris Davis, Cambridge.

The lively interest now aroused in Antarctic exploration suggests that the special attention of geologists should be directed to a problem of great interest that may possibly be solved by special studies in far southern latitudes. It is well known that fossil plants have been found in various formations in the Arctic and Antarctic regions, indicating the former prevalence there of a much milder climate than that of to-day. Our prepossession naturally favors the present polar climate as having been the ordinary or normal polar climate of all geological time; but inasmuch as milder climates have sometimes occurred, it is eminently possible that they, and not the present rigorous climate, may have been the usual polar climate through the geological ages. Hence a peculiar interest attaches to studies of the minute structures of stratified formations, particularly of such as are of continental origin; for from such studies it may well be possible to determine climatic conditions even in the absence of fossils. It is fitting that attention should be directed to this problem by its discussion before a society that, more than any other in this country, has promoted renewed interest in Antarctic exploration.

The Italian Riviera—A Study in Geographical Description: William Morris Davis, Cambridge.

After a geographer has seen a district it is his responsibility to describe it in such a manner that other geographers who have not seen it may get as clear a conception of it as possible. For this purpose experiment is here made on the picturesque Riviera Levante, between Genoa and Spezia, following the method which may be called the method of "structure, process and stage"; because the land forms observed are treated first in terms of the rock structures of which they are composed; second, in terms of the processes of sculpture that have worked on their surface; third, in terms of the stage of development reached by these processes in their task of the complete destruction of the lands. Briefly stated, the Riviera Levante is a district of deformed strata, for the most part sandstones and limestones of similar resistance, which in an earlier cycle of normal erosion was reduced to small relief; the lowland thus produced was then tilted to the southwest, and in this attitude it was maturely dissected by normal erosive agencies and maturely retrograded by the sea, with the result of having all its spurs cut off in great terminal facets along a simple shore line. This stage of development having been reached, the district was in recent time very gently tilted on an axis through its middle at right angles to the general coast line; and thus slightly elevated to the northwest and depressed to the southeast; as a consequence, an abraded marine platform was revealed in increasing height and breadth to the northwest; while the valleys and sea-cliff facets were submerged to increasing depth towards the southeast. Since this change took place, the streams have cut down mature valleys across the raised platform, and the sea has cut away its outer margin; while on the other side of the axis of tilting, the drowned valleys have been filled with delta deposits, and the cliff-facets have been somewhat steepened at

the new water line. The location of villages and the lines of transportation are shown to be closely related to the forms thus described.

Some Recent Results in Connection with the Absorption Spectra of Solutions: HARRY C. JONES, Baltimore.

The absorption spectra of dissolved substances are not simply a function of the nature of the substances, but also of the nature of the solvents. Thus in the case of solutions of uranyl chloride we have one spectrum in water, another in alcohol, still another in acetone and a spectrum in glycerol which is very different from any of the above. The only way in which we can account for these results is in terms of the solvate theory. The different solvents combine with the dissolved substance and form solvates having very different compositions. These affect the resonance of the vibrators that are the cause of light absorption, differently; and, consequently, the absorption in the different solvents is different.

The second point upon which stress is laid has to do with the action of one acid on the salt of another acid. In terms of prevailing chemical theories, when a salt of one acid is treated with a small amount of another acid, a part of the salt is transformed into the salt of the second acid. With the addition of more and more of the free acid, more and more of the initial salt would pass over into the salt of the second acid. In such solutions we should expect to have the bands of both salts occurring simultaneously, with varying intensity, depending upon the amounts of the two salts present. The fact is that when a salt is treated with a free acid, we have neither the bands corresponding to the initial nor the final salt present, but bands occupying positions intermediate between those of the two salts; and these bands can be made to occupy any intermediate position by suitably varying the amount of the free acid relative to the salt. This shows that between the initial salt, and the one finally formed, there is a series of intermediate compounds or systems, corresponding to the various positions of the bands.

The number of reactions showing the above relations is not small, and this raises the question whether chemical reactions in general are not much more complex than is usually represented by our chemical equations, which deal only with the initial and final stages.

The Propagation of Explosions in Mixtures of Petroleum Vapor with Air in Tubes: CHARLES E. MUNROE, Washington, D. C.

What Constitutes a Species in Agave: WILLIAM E. TRELEASE, St. Louis.

An analysis of the difficulties met with in obtaining flowering and fruiting material in the slow-maturing agaves; in finding spontaneous plants identifiable with many of the garden forms described as species; and in applying vegetative characters consistently and dependably. The conclusion is reached that though differing much in aspect, species of this genus are reasonably constant in their spine and prickle characters—illustrations being derived from the century plants, henequens, zapupes, mezcots and pulque magueys.

Suppression and Extension of Spore-formation in Piper betel: DUNCAN S. JOHNSON, Baltimore.

The interesting feature of the structure of the flower in this plant is the presence of male flowers, female flowers and flowers bearing the organs of both sexes, on three separate kinds of spikes. But flowers of each sex often bear some rudiments of organs of the other sex. This shows that while some flowers are apparently of one sex only, they really possess, in some degree, the power to develop the organs of the opposite sex. In other words, the cells from which the flowers arise are capable of forming the organs of both sexes, and the fact that one sex only is formed is probably due to some influence, internal or external, affecting the cells at the time that the flowers are being initiated.

Experimental work on certain plants has shown that a change in the light or soil supplied to apparently unisexual individuals may cause the organs of the other sex also to appear. This seems clear evidence that both sexes may really be present in all apparently unisexual plants, but that sometimes one, sometimes the other of these is suppressed or fails to become evident. The only plants of which this seemingly can not be true are those well-known unisexual plants like the sago palm, cotton-woods and willows, in which each individual bears only male flowers or only female flowers year after year, throughout the life of the plant. Another case is that of one of the mosses, in which it has been shown by Noll that the sex remained constant for thirty generations when male or female plants are propagated by budding.

A Method of Using the Microscope: N. A. COBB, Washington, D. C.

The Use of the Hydrometer in Phytogeographic Work: JOHN W. HARSHBERGER, Philadelphia.

The distribution of plants in salt marshes and along salt-water estuaries is determined by the percentage of salt in the water and in the soil. This can be estimated indirectly by a hydrometer reading directly the specific gravity of liquids heavier than distilled water, the readings being afterwards reduced to percentages of salinity. This specific gravity can be determined for each salt marsh and saline species of plants by collecting the water at the roots of the plants and estimating its salinity by hydrometer with a thermometer attachment. By this means the transition from salt-water to fresh-water vegetation can be studied.

Solar Activity and Terrestrial Magnetic Disturbances: L. A. BAUER, Washington.

A recent examination of the times of beginning of magnetic disturbances, as recorded at observatories over the entire globe, showed that, without doubt, magnetic storms do not begin at absolutely the same instant of time, as heretofore believed. Instead, they progress around the earth, the times generally increasing as we go around the earth eastwardly; for the quick and abrupt disturbances, which are usually comparatively minute in their effect on the compass needle, the complete passage around the earth requires from three to four minutes. For the bigger effects or for the greater magnetic storms, the rate of progression is slower, so that it would take them a half hour or more to get around the earth completely. There is thus introduced a new point of view in the investigation of the origin of magnetic storms.

In addition to negatively charged electrified particles coming from the sun to which recent theories sought to attribute our magnetic storms, but which the speaker found would produce effects not in harmony with those actually observed, we also receive radiations such as the Röntgen rays, for example, which are not deflected by the earth's magnetic field as they do not carry electric charges. Their chief effect will be to ionize the gases of which the atmosphere is composed, *i. e.*, make the air a better conductor of electricity. Ultra-violet light has the same effect. It is known that a small part of the magnetic forces acting on a compass needle is due not to the magnetism or electric currents below the earth's surface, but to electric currents already existing in the atmosphere and which the speaker showed were brought about by the atmosphere cutting across the earth's lines of magnetic force in its general circulation around the globe. If the regions of these upper electric currents are at any time made more conducting by some cause, electricity will be immediately set in motion, which in turn affects our compass needles.

This new theory, called "the ionic theory of magnetic disturbances," satisfactorily explains the principal features of magnetic storms. As the currents get lower down in the atmosphere their velocity is checked, so that instead of taking but three to four minutes to circulate around the earth, as do the higher currents, it may take them a half hour and more; however, their actual effect on the magnetic needle would be greater because of their coming nearer to the earth. The theory also opens up the possibility of accounting for some of the other changes and variations experienced by the earth's magnetism, and likewise has a bearing on the peculiar formation of the magnetic fields in sunspots discovered by Professor Hale.

Magnetic Results of the First Cruise of the "Carnegie": L. A. BAUER, Washington.

The non-magnetic vessel *Carnegie* completed on February 17 last the first cruise, covering in all since September 1, 1909, 8,000 miles. Special tests made at Gardiners Bay, Long Island, and at Falmouth, England, proved conclusively that there are no corrections to the magnetic instruments of the kind encountered on vessels in which more or less iron occurs in the construction. Thus in a single voyage errors could be disclosed in the compass charts used by mariners on their transatlantic voyages of importance not alone from a scientific standpoint, but from that of practical and safe navigation as well.

The errors found by the *Carnegie* in the declination at various points along the track followed by the vessel from Long Island Sound to Falmouth, England, amounted on the average to about 1 degree—an error which persisted in the same direction for long distances.

After leaving Falmouth, the *Carnegie* headed for Funchal, Madeira. Thence she sailed to Bermuda, and finally arrived at Brooklyn, February 17. In spite of the unusually adverse conditions frequently met with during this first cruise, more or less extensive magnetic observations were secured almost daily.

The errors of the compass charts were found in general even more pronounced for the southerly half of the cruise, viz., Madeira to Bermuda, than for the northerly half, and were again shown to be systematic in their nature. Some of the charts were in error two to three degrees.

For the entire cruise important corrections were also disclosed for the charts which give the lines of equal magnetic dip and of equal magnetic force.

The *Carnegie* is now being fitted out for a circumnavigation cruise of about three years. Meantime, the magnetic surveys of unexplored countries are pushed, so that it is confidently expected that by the year 1915 the general magnetic survey of the greater part of the globe will have been completed in sufficient detail to permit the construction and issuing of a new set of magnetic charts.

Spectra of Recent Comets: EDWIN B. FROST, Williams Bay, Wis.

On the Distances of Red Stars: HENRY NORRIS RUSSELL, Princeton.

Comparison of the parallaxes of stars, derived by the writer from photographs taken at the Cambridge Observatory (England) by Mr. A. R. Hinks and himself, and their spectra, determined at Harvard under the direction of Professor Pickering, shows a marked correlation between spectral type and parallax.

The proportion of orange and red stars (types K and M) among those of large proper motion, and especially among those shown by direct measurement to be our near neighbors, is very much greater than among the general run of stars of the same apparent brightness. Conversely, stars of the same apparent brightness and proper motion average nearer to u the redder they are.

It follows that these stars are intrinsically fainter the redder they are, the reddest ones averaging only one fiftieth as bright as the sun. On the other hand, many bright red stars (such as Arcturus) are at great distances, and are actually at least one hundred times as bright as the sun.

All this can be explained on the hypothesis (now well established on other grounds) that the reddest stars are the lowest in temperature. With the latest determinations of temperature and surface brightness, it appears that the fainter red stars are somewhat smaller, and presumably denser, than the sun, while the brighter ones are very much larger than the sun, and presumably of very small density. The latter class probably represent an early stage of evolution, and the former the latest stage that can be observed.

A Standard System of Photographic Stellar Magnitudes: EDWARD C. PICKERING, Cambridge.

Since 1879, about two million photometric observations of one hundred thousand stars have been made at the Harvard College Observatory. The results, published in volumes 50, 54 and 70 of the *Harvard Annals*, furnish a standard scale for determining the brightness of the stars in all parts of the sky, according to a uniform system.

The general introduction of photography in nearly all departments of astronomy has created an urgent need for a similar scale to give the photographic magnitudes of the stars. The two scales will differ, since red or yellow stars will always photograph faint. The scale proposed will be the same for white stars as the visual scale. Three methods are adopted in this work for determining the photographic brightness. First, correcting the visual magnitude by the class of spectrum. Secondly, by measuring with great care the photographic brightness of a sequence of stars near the north pole, and superposing this photographically on the stars to be measured. Thirdly, by attaching to the object glass of the telescope a small prism, a second image of each star, five magnitudes fainter than the principal image, is formed.

All three of these methods are in use on a large scale at the Harvard Observatory, and it is hoped that, as the result of many thousand measures, a satisfactory solution of the problem will be found.

The Existence of Planets about the Fixed Stars: T. J. J. SEE, Mare Island, Cal. (Read by title.)

Results of Recent Researches in Cosmical Evolution: T. J. J. SEE, Mare Island, Cal. (Read by title.)

Some Interesting Double Stars: ERIC DOOLITTLE, Philadelphia.

The many thousand double stars in the sky may be divided into two classes. There are some in which the two stars are not really near each other, but which merely happen to lie in the same direction as viewed from the earth, and there are others which form true systems composed of two suns revolving about their common center of gravity. In the latter case, measures show that one sun revolves about the other in an elliptic orbit. It often happens that a very few measures of such a system secured at certain critical times throw unusual light on the nature of the motion and the size of the orbit. This is especially the case when the companion star apparently ceases its motion in one direction and begins to move backward, and also when the companion is passing nearest the principal star. Several diagrams

were shown describing measures of this kind which had recently been secured. An account was also given of the discovery of a very close double star during its occultation by the moon.

Radioaction in the Heavenly Bodies: MONROE B. SNYDER, Philadelphia.

Radioaction the Cause of Hale's Anomalous Solar Spectrum: MONROE B. SNYDER, Philadelphia.

Certain Singularities in the Problem of Several Bodies: EDGAR ODELL LOVETT, Houston, Texas. (Read by title.)

Groups Generated by two Operators, each of which Transforms the Square of the Other into a Power of Itself: GEORGE A. MILLER, Illinois. (Read by title.)

The Origin of our Alphabet and the Race of the Phenicians: PAUL HAUPT, Baltimore.

The Phenicians were not of Semitic stock, but colonists probably from Crete or Cyprus. The origin of the alphabet can hardly be ascribed to them as the derivation of the letters points to their having originated among a more agricultural community.

HORACE CLARK RICHARDS

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SOCIAL AND ECONOMIC SCIENCE[1]

FOUR sessions of the Section of Social and Economic Science were held at the Boston meeting, including the first, at which the vice-presidential address was the feature; the second, at which social questions, such as divorce, immigration and public baths, were discussed and papers read; an economic and statistical session with papers on costs of public works, methods of assessments in taxation and general economic progress; and a final session at which were considered the tariff in its more scientific phases, timber growing, economic clubs, racial studies and the mathematical measurements of the economic earning power of the individual man. Out of fourteen assignments on the program, twelve of the authors were present and read their papers in person.

The vice-presidential address, by Byron W. Holt, on "The Gold Question" was published in the January number of *Moody's Magazine*, and J. F. Crowell's paper, on "Some Consequences of Advancing Prices," in the February issue of the same periodical.

[1] Boston meeting, December, 1909.

Among the papers of special scientific merit, embodying the results of research, were those of Harrison P. Eddy, C.E., on the "Desirability of the Contract System of Constructing Public Works," in comparison with other methods employed in municipal administration; and of A. C. Pleydell, secretary of the New York Tax Reform Association, on "The Need for More Scientific Methods of Assessment." The latter paper dealt with the conditions of corporate assessment under liability to local government units. Professor Lazenby's paper on "Timber Trees of Ohio" gave an instructive account of the growth of timber to meet specific commercial needs.

Under "Phases of Economic Progress in the United States," Col. Albert Clarke summarized the achievements in the following fields: aeronautics, automobiles, agriculture, hydro-electrics, canal construction and irrigation during the past ten years.

Fred C. Croxton, of Washington, outlined some of the results of the work of the United States Immigration Commission, with special regard to the adjustment of the immigrant to the various industries and occupations.

William H. Hale, of Brooklyn, described the work of the public baths administration in that city as evincing a tendency to look upon it as a public necessity, and reported that over 2,274,000 people had availed themselves in the eleven months ending November 30, 1909.

J. W. Beatson, of the National Economic League, Boston, reported on the extension of economic clubs in New England and eastern cities, with memberships ranging from 200 to 1,500 each, where nearly 500 subjects had been discussed.

Seymour C. Lewis, of New Haven, Conn., described the purpose and limitations of the tariff board as the first step in the direction of a scientific mastery of the tariff problem.

Samuel W. Dyke, Auburndale, Mass., summarized the present status of the divorce question in the United States, stating that the present ratio of divorce to marriage was about one to twelve; that the average length of married life before divorce for the past twenty years was 9.9 years, and that separation in 27 per cent. of the known cases occurs within less than two years of married life.

Dr. E. E. Holt, of Portland, Me., presented a paper on the mathematical formula of the normal earning ability of the individual, defining the

earning ability as composed of functional, technical and competing ability, and giving a specific value to each one of the elements of which the bodily organization was composed.

Papers read by title or by abstract were one by E. L. Blackshear, of Prairie View, Texas, on the "American Negro," and another by Alberto Pectorino on "South European Immigration."

JOHN FRANKLIN CROWELL,
Acting Secretary

NEW YORK

SOCIETIES AND ACADEMIES

THE BOTANICAL SOCIETY OF WASHINGTON

THE sixty-second regular meeting of the society was held at the Ebbitt House, April 23, 1910, at eight o'clock P.M.; President Wm. A. Taylor presided. Robert A. Young and Harry B. Shaw were elected to membership. The following papers were read:

Characteristic Floral Regions of Utah: IVAR TIDESTROM.

With the exception of the region about St. George and possibly along the Colorado River, Utah may be divided into the following floral regions: the river or swamp area, *Scirpetum;* the desert or mesa, *Sarcobatetum;* the foothills, including the lower cañon, *Quercetum;* the aspen region, *Populnetum;* the fir region, *Abietum;* there is no strictly alpine region.

The first mentioned region, *Scirpetum*, is characterized by *Scirpus occidentalis*, which forms dense colonies in places and can be distinguished at some distance by its dark green aspect. There are numerous other aquatic or swamp plants, but the rush is characteristic of the area.

The second region has a number of characteristic plants, among which abound species of *Chrysothamnus* and *Atroplex*, which cover large areas in places. The greasewood, however, is the most characteristic plant of that region, particularly in the saline areas.

In the foothill region are found the piñon and the Utah cedar, and in the cañons, *Quercus utahensis*. The latter is a shrub found at an altitude approximately between 1,500 m. and 2,000 m., and characterizes the *Quercetum*. In this region there occur a number of shrubs, such as *Peraphyllum, Cercocarpus* and others.

On the lower mountain sides *Populus tremuloides* forms a distinct belt. This region is very distinguishable from a distance, especially in the autumn when the leaves of the aspen have turned to a golden yellow, and it is bordered above and below by the dark cedars or piñons, with the still darker firs above. The aspens ascend the mountain sides to about 2,850 m. and higher under favorable circumstances. Mingled with the aspens and ascending above to 3,000 m. or higher, we find the Englemann spruce and the alpine fir. Both of these trees reach a considerable height in protected places but on the high ridges and summits they are sometimes reduced to mere shrubs.

Arbens lasiocarpa is the characteristic tree of the *Abietum*.

Apparent Mutations in Soil Bacteria: KARL KELLERMAN.

Agricultural Conditions in the Panama Canal Zone: WM. A. TAYLOR.

A general account of the agriculture of the Canal Zone as seen by the writer in a recent visit to that region. The primitive methods in vogue were illustrated by numerous photographs.

W. W. STOCKBERGER,
Corresponding Secretary

THE AMERICAN CHEMICAL SOCIETY
NEW YORK SECTION

THE eighth regular meeting of the session of 1909–10 was held at the Chemists' Club on Friday, May 6.

Professor Julius Stieglitz, of the University of Chicago, gave a talk on the "Electrolytic Theory of Oxidation and Reduction." This address was a logical and well-rounded application of the electrolytic theory to all classes of oxidation—by salts, by oxygen, by air, by nitric acid, by permanganate, etc., including oxidation of organic substances like sugar and formaldehyde. The main purpose was to show that this theory can be used in elementary chemistry and as a working basis in any chemist's every-day ideas of oxidation, without any difficulty whatever. The address was illustrated by numerous lecture table experiments.

Preceding Professor Stieglitz's address, the following papers were read:

"On the Action of Crushed Quartz upon Nitrate Solutions," Harrison E. Patten.

"Stilbazoles in the Quinazoline Group," G. D. Beal and M. T. Bogert.

"Estimation of Iodine in Organic Compounds and other Halogens," A. F. Seeker and W. E. Mathewson.

C. M. JOYCE,
Secretary